Project Malawi:
Teaching computing in schools in Malawi

An outreach project by the School of Computer Science, University of Manchester

July 2017

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Introduction

We describe a project to deliver Computer Science education to schools in central Africa, through a team of University of Manchester staff and students, and UK schoolteachers. We evaluate the effectiveness of this support for education overseas.

Context

Computing at School (CAS) is a UK-based organisation of schoolteachers engaged in computing education, with a current membership of over 25,000.

The University of Manchester is one of 10 **CAS Regional Centres** in England. These are government-funded centres, co-ordinated by the British Computer Society, with a remit to support schools and schoolteachers in their teaching of computing. The Manchester Regional Centre employs 4 staff and supports over 2,000 schools in the region.

The University of Manchester has three core “Strategic Goals”, one of which is Social Responsibility: “The university will contribute to the social and economic success of the local, national and international community by using our expertise and knowledge to find solutions to the major challenges of the 21st century, and by producing graduates who exercise social leadership and responsibility.” Project Malawi is an attempt to tackle one of the major challenges of the century, namely the

inequality of educational opportunities for children across the world. The **School of Computer Science** is one of the largest in the UK and with a top research rating.

Malawi is situated in south-central Africa, and dominated by the Great Rift Valley and Lake Malawi. It has a population of 18 million. It is ranked one of the poorest countries in the world in terms of GDP per head of population.

Ripple Africa hosted and supported the Project Malawi team. It is a UK-based charity with a wide range of activities in northern Malawi, including in education, agriculture, medical services, conservation and green initiatives.

We now describe the first (pilot) visit to Malawi in 2017, drawing conclusions about its significance and effects, and then the return visit in 2018 with a new team.

Project Malawi 2017

The Project: Preparation

With the expertise of the CAS Regional Centre team in supporting school computing education across the region, the outreach activities of Computer Science students in schools, and support from the University of Manchester, it was suggested by a member of the university staff that the model of educational outreach used in the UK might usefully be used in countries which struggle to teach technological subjects, with a suggestion that a pilot project could be undertaken in the summer of 2017 visiting Malawi, and, if successful, this could lead to a continuing relationship building links between the university and schools in Malawi.

Planning was long and detailed:

1. We needed a host organisation in Malawi, and eventually settled on the charity Ripple Africa, which has provided excellent support in the UK and in Malawi, and has a superb organisation for overseas volunteers.

2. The Volunteering and Engagement Team at the University of Manchester, in particular Emma Richardson, has experience of overseas volunteering projects and provided considerable support and help in the planning.

3. The School of Computer Science offered substantial support, with staff dedicating time to help in all the details of the planning and preparations, from transport to Risk Assessments, from funding to equipment donations, from liaising with outside organisations to ensuring the team was properly prepared.

4. Funding: The EPS Faculty generously contributed through its Social Responsibility fund, and the School of Computer Science has provided considerable financial support for the project. There have been a number of “crowd-funding” initiatives, raising a good deal of money, especially to support the charity and to buy equipment for the project.

We approached various companies and organisations for support funding, but without success – partly because we had limited time to set up relevant links and make applications. Some companies however have donated equipment for the project.

5: The team consists of the members of the CAS Regional Centre, one academic member of staff, a local Master Teacher, together with a carefully selected group of students, all of whom have extensive experience in schools activities and teaching children. The team was chosen to balance skills and to be able to work closely together in sometimes stressful and difficult circumstances.

6. Equipment: It was decided that all equipment needed would be taken out by the team, and all the equipment taken would be left for the Malawian schools to use.

Generous donations of equipment for Project Malawi included micro:bits donated by Nicholas Tollervey, Joe Finney at Lancaster University and the micro:bit Foundation; laptops donated by Lowerplace Primary School in Rochdale; Pi-tops supplied through the fund-raising of Jo Hodge and the generosity of Our Lady of Lourdes Primary School in Southport and its supporters; Barefoot materials were delivered to teachers to use in Malawian schools. In addition, equipment was donated by the University of Manchester, and a set of hand-bells by the Master Teacher on the programme.

5. Education: A preliminary timetable of access to the schools prepared by Ripple Africa was populated with a proposed series of activities for the schoolchildren developed by the CAS Regional Centre team.

6. The opportunity was taken to arrange a visit to Mzuzu University, the major university in northern Malawi, partly to discuss how to provide local support for the schools outreach.

The Project: Delivery

As a pilot project, it was decided to make a 3-week visit to Malawi with a small team of 3 university staff, 3 Computer Science students and one Master Teacher.

In Malawi, we focussed on three secondary schools, Kapanda Community Secondary School, Bandawe Girls School, and Bandawe Secondary School, with a visit to Mazembe Primary School as well.

A range of educational activities was planned and delivered including both “unplugged” (without machines) and computer-based activities. Unplugged sessions included teaching algorithms through dance, and through music including with hand-bells, programming “human robots”, and using Barefoot activities and materials. Computer-based activities, using laptops and pi-tops, included programming in Scratch using Code Club resources, programming in MicroPython on micro:bits using Mu, and building and programming cars with Crumble kits. There were multiple sessions at several schools most days, including at the weekends.

Schools were very enthusiastic to take part in the educational programme. Sessions were largely limited by the amount of equipment we could transport to (and around) Malawi, with 12 machines available, sometimes three children to a machine and sometimes running multiple sessions. In Secondary schools, we taught all Forms (1, 2, 3 and 4, with Forms of mixed ages). Primary Schools didn't have electric power so teaching was restricted to unplugged activities, and Primary children had limited English.

In all, we delivered about 80 hours of teaching in 50 sessions to over 200 school students across a large age range, from Primary-level to Form 4 at Secondary School. Girls made up about 40% of the children involved.

One of the university students provided technical support for computers and, indeed, using University of Manchester donated equipment, he built a networked computer lab for one of the schools, and helped repair and maintain machines in other schools.

One member of the team visited Mzuzu University – the local university and the main university in northern Malawi. This was an interesting engagement, in which the university expressed interest in establishing links with the University of Manchester and with our outreach programme and helping to develop the schools activities. They have previous experience of engaging with organisations outside the country to support schools.

Evaluation

As a pilot project, running under difficult circumstances, this proved highly successful:

(A) Schools, Head Teachers and teachers were very keen on our participation.

(B) Schoolchildren were keen to engage with the subject and saw it as a connection with the wider world. They were ready learners, and could clearly see the point of this education. The level of activities was pitched just right. Some were inspired to take these studies further. Experience with technologies new to them was a positive aspect of the project.

The combination of unplugged activities, especially in the first week, with computer-based activities later, worked well, with the unplugged contributing to an understanding of the computer-based activities. The smaller class numbers and the unreliable power for computer-based classes made this a good arrangement for the teaching.

(C) The team worked well together to deliver interesting Computer Science in a range of formats and using a range of technologies. The work was intensive and adaptability was key, developing activities on-the-fly as required.

(D) Equipment was transported and deployed successfully, with some effort required to maintain the equipment in working order.

The pilot allowed us to evaluate the feasibility of such a project, its impact and value, and how the project should be developed in future years.

Impact in schools: It is clear we enthused a large number of Malawian schoolchildren, numbers limited only by amount of equipment available, the number of members of the team available to deliver sessions, and the number of schools we had contact with. Schools and schoolteachers were very enthusiastic about our participation.

The acting Head of Kapanda Secondary School said:
"This is wonderful, an ideal contribution to the children's education. Schools in Malawi suffer from a lack of equipment and a lack of skills and feel they are left behind in technology. The team's work is ideal – at the right level and with the right material."

One of the teachers who attended the teaching sessions wrote:
"It was a great experience. I learnt a lot and had some of the questions I had answered directly or indirectly. I was really pleased with the team's commitment and patience as most (all) of the students have never worked with this equipment before". "I intend that all of the equipment will be used to teach [in the future], not just what we have learnt but also to explore other possibilities".

I**mpact on team members** was entirely positive, with an enthusiastic endorsement of the project and the experience: "Fantastic – I'd do it again" (DA), "It was a great thing to do" (TT), "Thanks for such an amazing opportunity. I think it was most definitely one never to be forgotten. I have already had an assembly for year 6 and have written a collective worship for my school which talks about Malawi and how we can be good neighbours!" (JH). "Made me realise how lucky we all are. Will never forget the smiles despite their poverty." (JH) "It was amazing … I would do it again in a flash. It makes you appreciate a very simple way of life and how people can be happy without all the stress of modern day technology. It also opened my eyes to similarities in which children and teachers learn even in such different environments…" [SZ]

Ripple Africa have also endorsed the project and their involvement with it, encouraging us to do something "bigger and better" in future years.

Issues:

1. The "CAS model" for supporting computing in schools is to train Master Teachers, who then provide CPD for teachers, who then have the skills to deliver Computer Science in schools. Whilst at some schools, teachers participated in the sessions, at other schools this did not happen and contact with teachers was sporadic. It is clear that a different approach is necessary to engage with teachers, something that is vital for "legacy": for Malawians to take charge of this education. We will address this aspect of outreach in the future.

2. Most of the schoolchildren had no access to a computer, had not used a computer before and had no basic skills, such as those required to operate a keyboard and a

mouse. Although this was recognised in advance, it is clear that dedicated lessons in keyboard skills and other basics are necessary for students to be able to program.

Whilst we delivered a graduated series of activities for the schoolchildren, it was not structured as a course. This was deliberate as it gave flexibility for delivery. However, courses with a certificate would be desirable but would ideally require a longer visit and a larger team. On-line courses (with certificates) may be an option, if Internet access can be arranged. There is also a need for material on “computing in context” including career options.

Teachers were interested in this style of teaching through activity-based learning, as opposed to the more instructional style traditional in Malawi.

3. Infrastructure: All the Secondary Schools we visited had electric power, but with limited access and sometimes not in a safe condition. The Primary School had no electric power. Internet access for the schoolchildren was difficult or impossible in all schools.

Some schools had old computers in “Computer Labs” but these were non-operational. There were no technicians, teachers had very limited skills, and schools could not afford to repair equipment. Part of the work of the outreach team was to improve this situation, if only temporarily.

4. Language proved only a small barrier in Secondary Schools, which all teach English, and some teach only in English. However, in Primary Schools, children had very limited English and a translator was required.

5. There was no opportunity to run out-of-hours “computing clubs” on this visit, but instead schoolchildren came for weekend teaching sessions on both Saturdays and Sundays – showing considerable commitment.

6. As in the UK, there is a gender inequality in Computer Science in Malawi. At Mzuzu University, there are large CS classes without any female students at all. There are cultural difficulties in Malawi, with many women dropping out of education early, and expectations for women often prevent engaging in technical subjects. We were therefore delighted to have the opportunity to deliver sessions at a girls’ school, and it was clear that girls were keen to engage with the subject and felt no inhibitions in doing so – and expressed their appreciation of both the chance to do so and seeing women in the team teaching the material.

7. The support from Ripple Africa was invaluable, not only to host the team, but also for logistics, especially to provide transport between schools over difficult, sometimes dirt, roads, to liaise with the schools and arrange access and a timetable for us to visit schools, and to provide an equipment ‘library’ for schools.

8. Primary teaching. Some of the team would like to see more Primary teaching, even though the Primary School we visited had no power, and the children had little English. We need to consider this carefully, and how we arrange and justify Primary classes.

The justification in the UK is clear – Primary children are already exposed to considerable computing resources, have the opportunity of taking computing qualifications later, and will need computing in many jobs they take later in life. The justification in Malawi is different and what we can teach perhaps is different.

9. Help with maintenance and operation of computing equipment: This turns out to be an important aspect of the visit, helping schools repair and operate their equipment (if any) and maintaining the equipment we take out in running order. This year we were fortunate in having a student with considerable expertise in this area. In the future, we should plan technical support.

10. The question of “legacy” looms large in a project such as this, and needs to be addressed properly, through a series of initiatives, including engaging with teachers, with local universities, addressing the equipment and maintenance requirements, and continuing the support for the schools throughout the year.

11. The question of “reach” also looms large. In this pilot project, we showed how a small number of schools can benefit from UK input. To extend this more widely across Malawi, we need to consider a number of factors and engage with existing organisations in the country, including universities.

There are more general issues, including the efficiency of this form of support in which personnel and equipment are transported at considerable cost over long distances. It is clear that countries such as Malawi have a widespread reliance on outside funding and services from other countries, and from NGOs, including a large number of charities and religious organisations. There is a lack of any real co-ordination between these providers to allow a more comprehensive and “joined-up” delivery of services, and there is little sign at a national level of a movement away from this reliance and towards a more sustainable national provision of high-quality basic services.

Summary

The pilot of this project to develop Computer Science education in schools in a sub-Saharan African country was successful and showed clearly the feasibility of the scheme developed by the School of Computer Science at the University of Manchester, with the Computing At School team, and hosted by Ripple Africa.

Schools, schoolteachers and schoolchildren across a wide range of ages were enthusiastic about the programme and, despite limited or no exposure to computing equipment, schoolchildren quickly engaged with the activities, including developing ‘computational thinking’ and programming in Scratch and Python.

The pilot also showed directions in which the project may be developed, with more substantial and lasting impact, in future years.

Project Malawi 2018

In 2018, a new team was assembled to visit the same area of Malawi, again supported by Ripple Africa and bringing computing to Secondary and Primary Schools.

1. The team visited for 5 weeks, instead of 3, in order to have a bigger impact with teachers and schoolchildren.

2. A larger team was assembled:

(a) From the 2017 visit, it was clear that the involvement of UK teachers brings a high level of professionalism to the planning and classroom delivery, so the team this year included 6 UK teachers, including Dave Ames, who led the teaching activities and was the only member of the team to stay for the 5 weeks.

(b) The 2017 visit showed us how useful, indeed essential, it is to have someone to provide technical support. This year, an Experimental Officer (Sam Walsh) from the School of Electrical and Electronic Engineering (EEE) provided technical support for (a) the schools, including renovating computer labs and reinstalling software; (b) for the team, including transport and maintenance of equipment (including a drone this year); and (c) technical support for the hosting charity. This was a successful innovation and Sam took responsibility for teaching equipment, as well as providing a useful additional member of the team when required, both for teaching and for supporting the team. The involvement of EEE was also a useful innovation. Sam reported:

- Equipment needs casing to protect from dust and dirt.
- A toolkit is needed on-site permanently
- There was a school student tasked with technical maintenance
    - Sam spent some time training him
- Even where there was electric power, the power supply was intermittent. We really need additional energy supplies (solar or battery packs) so that classes are not interrupted by power outages
- Electrical supplies in schools used cheap, quickly deteriorating cables, sockets, switches, etc. Suggest we take UK-quality supplies out to provide better infrastructure.

(c) The involvement of university Computer Science students continued with 4 students this year (3 UG, 1 PG). Students both benefit themselves and bring additional benefits to the project, supporting teachers and being role models for the Malawian children.

Composition of the team is important: There was a good gender balance amongst the UK teachers and amongst the students – this is important because of the low status of women in Malawian education, in technical subjects, and in society in general. We taught both mixed classes and girls-only classes.

3. We instituted special sessions for Malawian teachers, in subject knowledge, in the use of equipment, and in classroom delivery of the subject. In the first few weeks, approx half the time of the team was spent on teacher-only sessions. The success of this is essential for a sustained impact of the project. Whilst some teachers in some schools where dedicated, attendance at these sessions was variable. However, we had much more influence with teachers this visit and it is much more likely that they will use the teaching material and the equipment after the visit [DA].

4. Secondary and Primary Schools: As in 2017, we concentrated our efforts on local Secondary Schools, but made time to visit and provide activities for Primary Schools. Again, Primary Schools had the problems described previously with very large classes (some 120) and no furniture, power or equipment. However, a range of unplugged activities, including algorithmic dancing and robot instructions, were well received.

5. Teaching materials: UK teachers prepared teaching materials based on existing sources here in the UK, including Barefoot (https://barefootcas.org.uk). This was delivered to teachers, delivered in classes to demonstrate its use, and given, with "schemes of work", to the schools for continued use.

6. Equipment: Some of the equipment from 2017 was still usable, and additional equipment (laptops, pi-tops, a drone, electrical supply devices and software) was taken out this year.

7. Transport: In 2017, Ripple Africa provided transport for the team around the schools. This year, the team hired a vehicle for the duration and one member of the team acted as driver. This was an expensive option, but provided greater flexibility and imposed less on the hosting charity. In return, the charity provided bikes for local transport for team members. This was a successful arrangement.

8. Leisure activities and "seeing the country and its people". In 2017, there was little time for team members to do anything but teach in schools, including at the weekends. This year, we planned for the students to have additional time, and they used this constructively to see Malawi, including local resorts and a safari.

9. The live link-up between the University of Manchester and the team in Malawi was a successful innovation which could be extended.

10. The importance of safety, emergency, insurance and risk management in planning Project Malawi was highlighted when an emergency arose, needing one member of the team to return to the UK immediately with an escort. The procedures provided by Ripple Africa, the University of Manchester, the insurance company and Project Malawi worked well on this occasion.

The impact on team members of their visit to Malawi was, as in 2017, extraordinary:

Hannah Berrisford (3rd-year CS student) wrote:
"It was such an amazing experience! Living in the middle of the community and being able to make a difference to the education there. It was so rewarding and I'm really

glad that I went, even though we had to ride a bike through the sand every day! We did a mixture of unplugged lessons with the primary schools, and we worked with the Microbits with the secondary schools. It was challenging working with the secondary schools because everyone had such varying experience with the computers. We spent quite a lot of time teaching basic things like how to turn caps-lock on with some students, but other students got more into understanding the code and even showed their code to their friends and taught them how to do it - which was very rewarding to see! “

Sam Walsh (EEE Experimental Officer) wrote:
"I had a fantastic time and learned a lot. I am very appreciative of the opportunity - thank you.”

Here are some suggested improvements to Project Malawi or new ideas suggested for future visits:

- Certificates for teachers and schoolchildren, especially providing support for accredited courses. This is important, both to teachers and to the schoolchildren, as such certificates have considerable value in the job market in Malawi. We looked for suitable courses, but failed to find any that we could deliver successfully in Malawi. There is also the requirement to map activities to the curriculum. However, the national curriculum lacks detail and so this appears not to be of value. There may be more detailed descriptions of what should be taught, eg for examinations.

- Teaching teachers – this was implemented, but only partially successful. Courses were 2 weeks and 12/15 were booked, but sometimes none attended. It varied from school to school, with some schools more reliable.

- Involvement of Mzuzu University [DR]: In 2017, a member of the team visited Mzuzu University to set up links with the University of Manchester, but also to try to benefit Malawian schools combining the expertise in computing available in the university with that of Project Malawi. Whilst we have had continued conversations with Mzuzu University, it appears that it would be difficult to set up formal links with the University of Manchester (in Computer Science at least) and the idea of Mzuzu University supporting their local schools in computing has not been taken up.

- A suggested [CK] “student ambassador” type of scheme, where we train school students, and they then present what they have learnt to others, in the classroom, or in computer clubs.

- The mobility imposed on teachers by the government poses a problem for this type of project [CK] when teachers are moved around the country. It makes it impossible to form a “community of practice” over a sustained period. Should highlight this problem, and possibly seek other sources of funding for teachers?

- The “rolling personnel” of the team, where team members leave whilst others arrive, is a successful model, allowing more participants to be involved, equipment to be ordered and transported, etc. However, it is suggested [CK,BP] that individuals should be expected to go for longer periods – making better use of the funding and the skills learnt onsite.

- Teaching other teachers [CK]: Maths and Science teachers would benefit from computer skills and also the use of computers in their subjects. Talk to them – for example how computers might help teach co-ordinate geometry.

- The technician could spend some time teaching teachers (and pupil ambassadors – see above) on the use of equipment so that there would be more chance of good use being made of equipment donated to the charity and schools. [BP]

- Funding: We are grateful for a contribution from the UoM EPS Social Responsibility fund and the School’s outreach budget to enable us to run Project Malawi 2018. In a new departure, both the UK teachers and the UoM students raised considerable funds through fund-raising activities and charitable giving. This allowed us to contribute both to the hosting charity and to expenses for the team members. In addition, there were donations of equipment and software from the School, from organisations and from UK schools.

  As in 2017, we failed to get funding from companies and other organisations and individuals outside the university (despite applying to a range of companies). More could be done with more funding. It is suggested [BP] that we approach companies supporting the UoM-run Hackathons. Other suggestions include the SCS Industry Club, our alumni, our industry contacts and other organisations involved in outreach to sub-Saharan Africa. We could also generate funding from our current outreach activities to contribute to further visits to Malawi.

- DA met the local Director of Education, but he didn’t seem engaged with what are doing or trying to achieve.

- There is a big demand by teachers and schools for more “Digital Literacy” (word-processing, spread-sheets, powerpoint, simple database use, together with keyboard skills). Could alternate days – some days teaching DL others CS [DA].

- Connectivity was better in 2018 than 2017, both phone and internet, making it possible to download material as required and keep in touch better. Still didn’t manage to have a “blog”-type activity though.

- The formation of the team for Malawi should be undertaken much earlier in the planning cycle – well before the New Year [DA]. This would enable fuller planning, better team integration, and more opportunities for fund-raising.

- Equipment – need a larger supply eg of laptops. Could get refurbished laptops, with new batteries and power supplies (essential as power is a problem) [DA].

Overall, we achieved considerably more in the 2018 visit than the previous year, and the major innovations were successful. Again, we noticed the enthusiasm of the schoolchildren to learn. Many moved from no experience with computers to being able to program applications, including small games, in several weeks. The children found keyboard skills fun to learn. Teachers asked for more IT skills.

The longer-term aspirations of such a project need careful consideration. The current structure, financial support and management allow us to assemble small teams for short periods each year. Addressing questions of long-term sustainability, the impact across Malawi, rather than locally in the area we visited, and interactions with the government of Malawi and the large number of charities in the country, all require a considerably larger scope of project than currently possible within the university.


The Computational Thinkers
Barefeet
Scratch


HATEVER
APPENED
DIDN'T