Mobile offline networked learning for teacher Continuing Professional Development in Zambia

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ABSTRACT
Networked learning enables learners to access and create digital resources and learn with peers, supporting the co-construction of knowledge (Goodyear et al. 2005). However, for many in developing countries, internet access is too expensive or unreliable. We have explored an alternative, using low-cost, battery-powered small computers as networked hubs enabling learners to work together and share resources in proximity using their own WiFi-enabled mobile devices (e.g. smartphones). This takes advantage of the mobility of the devices and users, domestication of smartphones into everyday practices, and offers network-enhanced collaborative learning independent of the internet. We call this approach 'offline networked learning' (Kukulska-Hulme et al. 2020). Here, we consider one collaboration supporting teacher education in Zambia. Teachers in sub-Saharan Africa can be limited in their access to effective continuing professional development training (CPD), impacting their capacity to learn from best practice and improve their teaching approaches. This is compounded by a lack of physical resources such as training guides. Internet or cellphone services are seen as an innovative way of supplying digital resources and online training, but are hindered by limited or expensive network coverage, leaving poorer-resourced and more remote educators behind. Our tools enable these teachers to work collaboratively accessing digital resources, supporting them in developing new practices where network access cannot be assured. We report on work-in-progress and the initial experiences of an ongoing pilot within the ZEST (Zambian Education School-based Training) project, where university educators have worked with local educators in CPD workshops and introduced network hubs with open educational resources for onward use by school-based teachers. Work so far suggests an offline networked learning system offers a potentially sustainable element of a practice-based approach to teacher development which supports shared knowledge co-construction in schools with limited network access, enhancing current provision; and already shows hints of appropriation to support locally owned educational purposes.

Author Keywords
Offline networked learning, Zambia, collaborative learning, CPD, teacher education, LMIC, sustainability

CONTEXT
The UN Sustainable Development Goal 4, "[ensuring] inclusive and equitable quality education for all" (United Nations, 2015), can only be met if countries have teachers that are "adequately equipped with the knowledge and skills to enable effective student learning" (Power 2019 p.47). The Open University (OU)-led Zambian Education School-based Training (ZEST) project, supported by the Zambian Ministry of General Education and delivered in partnership with World Vision Zambia, seeks to provide resources and a set of activities for teachers, to be used and undertaken as part of the existing school based CPD system, focused around teacher group meetings (Stutchbury et al. 2019). The approach emphasises collaborative learning through planning, practise and reflection, building 'knowledge of practice' and 'knowledge in practice' (Cochran-Smith and Lytle 1999). It has been prompted by a revised national curriculum which calls for learner-centred education and inclusivity, and the need to build teacher capacity for its delivery. Initial plans sought to distribute paper-based guides, and digital open educational resources (including audio-visual materials) via SD cards for teachers' mobile phones, the latter inspired by the success of a large scale programme in Bangladesh (Walsh et al. 2014). However, given the prevalence of smart phones and the project's pedagogical emphasis on teachers learning together (Gallastegi et al. 2019), a digital learning approach that enabled collaborative working and co-construction of knowledge was attractive, and a decision was taken to explore Raspberry Pi computers as offline network hubs for content provision, building on the OU's prior experience in the area. This approach was considered to offer more functionality, the potential to reach more users, and a higher likelihood of long-term sustainability.

APPROACH
Offline networked learning enables the advantages of networked learning in situations where internet or cellphone access to network infrastructures is too poor or expensive, and a number of different approaches have been explored to support education in a variety of settings, particularly in low- to middle- income countries (e.g. Cristol et al. 2019, Hosman et al. 2020). Low-cost, battery powered, network hubs such as Raspberry Pis enable participants to connect at no cost to shared resources via their own WiFi devices such as smartphones that are already familiar given the widespread domestication of these devices into everyday practices for many people globally (Gaved and Peasgood 2017). Independence from the internet and mains electricity allows mobility of both learners and devices, creating hyperlocal networks wherever they are set up. Widely available hardware and open source software increase the likelihood of local maintenance and onward sustainability. As a digital pilot element of the overall ZEST project Raspberry Pis were configured with a customised

software toolkit ('MAZI') providing a range of open source software tools, that had been devised and trialed in over 40 community learning scenarios in an earlier project where the OU had played a central role (www.mazizone.eu). For the ZEST research team, the key role of the offline network hubs was to enable the dissemination of teacher CPD materials (open educational resources) created to support teacher professional development and collaboration. The digital capabilities of the participating educators and capacity of the local technical support team were to be gauged in the pilot phase to understand what would be sustainable in the long term, so initially, the MAZI system was purposefully simply configured and focused on a single tool, the web-based file sharing system, NextCloud, with ongoing discussions about future possibilities. While the Raspberry Pis running MAZI had been trialed widely in Europe, this was the first experience for the OU team in Zambia so the technical capacity of the hardware itself was under examination (e.g. performance under heat and dusty conditions). Most important was integration of digital tools into a way of working (teacher-owned, socially constructed learning) rather than just a technology tool to bridge the digital divide.

FINDINGS

The offline networked learning system has proved to be a usable and useful component of the ZEST project enabling collaborative, network enhanced learning in locations where internet access is not feasible. So far (July 2020), a successful proof-of-concept trial has been undertaken in 7 schools and one district office, that as a result has now moved to successful deployment in 11 further schools and another district office as part of a year-long pilot, enabling teachers to learn together using digital, open educational resources incorporating text, audio and video. Teachers and the local technical support have engaged enthusiastically with this innovative way of working together with teaching resources. There have been challenges managing expectations of what these low-cost computers could do (e.g. how many participants could simultaneously watch a streamed video, how far the WiFi signal would carry) and recognition of the complexity of the technical ecology, for example, having to manage audio issues because of differing browsers on smartphones, the need for battery power and consideration of solar power because of unreliable electricity supplies. Some issues arose because of differing prior experiences with digital technologies, often in this context first encountered by teachers through smartphones and not on a route from PCs to laptops to smartphones. For example, some teachers were unfamiliar with the term 'browser' as this wasn't used in conversations around phones, so the instruction "go to your web browser" in the training guide was unfamiliar, exposed as being biased toward the UK educators' experiences rather than those of local teachers, and had to be re-written. This pilot process has led to a better understanding of technical support capacities, appetite for development, and resulted in local innovations: e.g. teachers supporting each other and working in pairs/groups, or materials displayed via a projector, to enable teachers to collaborate with digital resources if they don't have smartphones. While the system was primarily intended to support dissemination of centrally produced resources and enable collaborative discussion around these training materials, we have nevertheless seen signs of appropriation by schools. For example, teachers have recognized the opportunity to use the file sharing tool as a school intranet, creating their own folders and uploading and sharing training materials from other sources, class videos, photos and school documentation. This has led to an unexpected benefit for district officials, who can log into the Raspberry Pis on their visits and see what has been stored, providing evidence of teachers' engagement with CPD that previously had been difficult to track and monitor. The advantages of being able to update the materials and add more relevant OER as they become available is also becoming evident.

CONCLUSIONS AND FURTHER WORK

The Raspberry Pi hubs have enabled teachers to use their personal devices to access digital resources, co-construct knowledge and explore possibilities in their own schools to inform and develop their teaching practices. The project team has a greater understanding of educators' and technical teams' capacities and enthusiasms and provided insights for future engagement, through the pilot phase trial. Onward use has been considered in further schools, and there are plans to explore the running of a virtual learning environment on the Raspberry Pi hubs (e.g. Moodle), which would enable recording of participation: highly valued as teachers have to show they have engaged with CPD to maintain their registered professional status. For uptake and onward sustainability, the approach needs to be seen as educationally valid; technical capabilities need to be nurtured; and political support gathered: both local ownership by schools and technical teams, and Ministry support. It is crucial that technical systems are part of a wider pedagogical approach to learning that has buy-in from educators and officials, as well as technical staff. It has been important to keep expectations realistic about teachers' levels of digital expertise: training, guided introduction, and ongoing support are critical and research teams must reflect on how such support will be resourced and maintained. Intended as an aid to enhance teachers' collaborative learning, the offline networked learning system has exposed schools to new ways of digital working that is affordable to them, and hence triggered reflection around their onward use of ICT in education and helped increase digital capabilities. This work has informed conversations with other deployments elsewhere, for example in community education in Togo (Miade Net - https://togo.drlab.org/) which aims to increase learning opportunities for youths on the streets, artists, and young entrepreneurs; and the collection of community mental health resilience video stories in Guyana (http://www.open.ac.uk/blogs/ARCLIGHT/). The current Covid-19 pandemic has impacted forward plans for ZEST but the functionality of the Raspberry Pis, through creating a 'hyperlocal network' that allows participants in socially distanced proximity to work together and share resources without physical contact, has enabled continued CPD, collaborative learning and digital resource sharing through the pandemic.

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