

Technology-Enhancement for Papua New Guinean Professional Learning

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Technology facilitated the implementation of teacher professional learning based on a design of principles to improve the teaching of *Cultural Mathematics* in elementary schools in Papua New Guinea. An offline ‘website’, a set of interlinked resource materials was used in workshops to enhance the professional learning. Appropriate and relevant content was needed together with consideration of the teachers’ backgrounds.

Improving quality elementary teacher training that is sustainable and accessible to all schools in Papua New Guinea is an issue that needs to be researched and addressed by all stakeholders. Many remote schools are relatively inaccessible except for the villagers due to difficult terrain and lack of infrastructure (De Albuquerque & D’Sa, 1986). In the current project, workshops are held in accessible but still remote areas. Taking teacher professional advancement as the objective, we go beyond the conventional in our attempts to produce quality ways of meaningfully engaging teachers in their learning of how to teach cultural mathematics. Information Communication Technologies (ICT) are used to secure advancements in professional learning by teachers. This in turn can improve students’ opportunities for inquiry learning which will be an advancement during the children’s earliest learning experiences (Gerard, Varma, Corliss, & Linn, 2011). Papua New Guinea’s lack of ICT facilities in most remote rural schools (Rogers, Bleakley, Ola, & CARE Integrated Community Development Project Team, 2011) is a challenge to this part of the project. This paper describes the design and implementation of ICT resources to enhance professional learning for Elementary School teachers, and in particular a resource of interlinked materials in a website format that can be loaded onto laptops and accessed offline. Despite being used offline at this stage, we use the term *website* for this resource both because the design is the same as if it were online, and because the eventual goal is to have it accessed online when the facility becomes more available in Papua New Guinea.

Some of the teachers who participate in the workshops are provided with a laptop by the project. The laptops can store all teaching resources including video files of cultural activities, teaching samples of learning plans using the cultural activities, readers, and indexed set of principles set up as part of the design of principles, all with easy-to-read notes. Video footage is a powerful tool for teachers to use in the teaching of cultural and classroom mathematics. Teachers see different activities and can construct models with or without the help of an Elder who may be skilled at a particular cultural activity. Seeing how the lessons are taught is also useful especially for those elementary teachers who have had little or no practical teacher training. Critiquing learning plans in a mutually supportive community can be harnessed through the use of this technology (Gerard, Varma, Corliss, & Linn, 2011).

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Principles for the Design

Sustainability: Defined as able to last or continue for a long time, a sustainable web-based technology resource may last for at least 2-4 years if the laptop and solar power system is handled by one person but is accessible to other elementary teachers and used solely as a resource tool rather than an entertainment device. As many remote schools have no power, our preferred way of generating the electricity required to use the laptops is solar. We are also looking at how mobile phones can be used so they can last for some years.

Ease of use: The objective of the design is a user-friendly website. Some elementary teachers, especially those in remote villages, may have minimal or no use of technological devices including laptops. There is basic electronic or manual documentation made available on how to access the materials. The teacher-in-charge (TIC) is provided with training on how to use the website with all its resource materials from video files to learning plans. The TIC is given instructions on care of equipment and use of the laptop's facilities for planning and recording information, maintaining virus protection, and the importance of ethics in using electronic devices.

Engagement of teachers to both read the professional learning materials and engage in preparing and implementing mathematics lessons by using local languages and cultural practices: After the initial workshop, the TIC can use the laptop with the website files on it to access the teaching documents including video footage of cultural activities which can be used as resources for learning plans. Other cultural activity videos can be made locally as an introduction or for going further in the mathematics or in taking action as appropriate to the learning plan's purpose.

Building a community of practice of teachers implementing this approach: Sharing learning ideas using mobile phones allows discussion groups of common culture formed through this medium. Where the internet is available, given remoteness and cost to buy time on the phone, full learning plans can be shared. Sharing information and ideas using this technology is a new culture in education and should be harnessed especially among teachers.

Phases of Research

Phase 1: A website was developed presenting the key principles for *Cultural Mathematics* education. It uses the content of the hard-copy workshop manual. The manual is supplemented by additional materials: video of cultural activities; readers on mathematical ideas suitable for Papua New Guinea children; videos of children learning (currently from Australian, but being replaced by Papua New Guinea footage); video of face-to-face workshops with teachers or a trainers' discussion of the material (in development); exemplar activities; and a collection of Papua New Guinea counting systems of most languages of Papua New Guinea, and measurement practices associated with different ecologies and languages. Ethnomathematics information was collected in Papua New Guinea over 40 years (Glen Lean Ethnomathematics Centre, 2008).

Phase 2: Workshops will be conducted for TICs using the computer with minimal face-to-face introduction. Anticipated challenges are sustainability of the solar panels, laptops, batteries, cameras, mobile contacts; cost of equipment but it is reducing; equipment connectivity and availability; organisation of distribution of equipment and workshops for teachers; little knowledge of users of how expensive, useful, and fragile such equipment is,

and the current disparity of the cost of the technology with that of other aspects of the teacher's life such as pay or housing.

Phase 3: Teachers will use equipment to assist them with their own teaching. The computer provides books that can be read with the class or small groups relevant to cultural mathematics. Pictures and videos can be taken on the computer or a camera, which we may supply. When people own mobile cameras, taking photographs is common place. This phase will also require some instruction on ethics of taking photographs and videos; how to use such materials for engaging children; how the photographs and laptop software such as Microsoft Word and Excel can be used for planning; and more information on how the computer can be used for reporting to parents using illustrated stories of children's learning.

Return visits to villages to see how the computer is being used for teaching will be made. Teachers can also comment via the teacher questionnaire. We do not aim for a laptop per child, which require more investment, solar power and internet connection than are currently available, We would like a laptop per teacher. Recent reports of use in Papua New Guinea are not easy to find, suggesting that a laptop for each teacher is a much more feasible project.

Comments on Design-based Research of Technology-Enhancement

Development of the Website

The simple website developed by Vagi Bino has a menu across the top and drop-down menus on the side to provide easy access to the materials. The main menu consists of the principles in the design for professional learning and a background tag. The home page provides a figure with details of all the principles for the teachers' professional learning. The website is a stand-alone program that does not require the internet. With a touchscreen, all the files can be accessed on touch. Many files also contain further hyperlinks to other files, particularly video examples. With the current status of the website and touchscreen computers, opening videos files with the usual CTRL-CLICK on a hyperlinked text requires Windows Media Player as the default program. The site is being modified after trials to both improve ease of use and extend and replace some of the video resources. Currently many videos on children's early learning of mathematics are from Australian sources and so require replacement.

Use in Workshops

In workshops, it was evident that web-based teaching was meaningfully engaging the teachers. The videos of Elders engaging in cultural activities stimulated conversations about the activities and the mathematics to be found in them. The participants were able to re-enact some of their own cultural activities during the group work. Children's activities in Australian schools also stimulated activities, for example making shapes with their bodies which they linked to their cultural activity of weaving the pattern called 'diamond'. Teachers were spontaneously creative in their preparation and peer teaching of their learning plans. The Australian videos on children learning to count were very effective in teaching principles about children's early arithmetic and in carrying out the individual assessment of children. For workshop facilitators, the computers allow the use of projected

notes placed in the web-design and video examples. The hard-copy manual remains essential when there is no power or the data projector breaks or is unavailable.

Engagement and Use by Participants

Leaving the computer and flash drives with the material for access by participants after the day's workshop in remote Saidor, Madang Province, it was found that the participants who already owned laptops quickly pulled up files and re-watched the videos with many on-lookers. The phases of the research began to overlap unexpectedly as participants yearned to take away the materials. The use of the touchscreen was effective. Both the content and the technology engaged all the participants. Laptops are a commodity that is valued but it is essential that they are properly used and the content valued and shared. It was found that more computers would have supported the spread of the principles by elementary school trainers.

Sustainability of Equipment

Our observations during trials have emphasised the importance of bringing equipment with knowledge of its care. Flash drives, readers and games have been lost. One computer and a data-projector were damaged from power surges when used with a generator. The first trial with a solar panel required the purchase of a non-touchscreen computer so that there was an available connection between solar adapter and the computer. The solar setup was also expensive. Preparing and trialling equipment has been a vital part of the development of the technology-enhancement.

Conclusion

Providing technology-enhancement for professional learning in Papua New Guinea has many challenges. Currently, sophisticated interactive online facilities are not feasible or appropriate. The use of a stand-alone offline website is proving to be a useful tool in professional development workshops. Teachers are engaging with the materials, especially the videos on the computer. While there is much to be done to improve the connections of video materials to the lives of the elementary teachers in different parts of the country, we have a very good start.

The computers themselves, the videos and the website design engage teachers. While the development of this technology-enhancement is in its first phase, the potential for quality professional learning for teachers in remote areas of Papua New Guinea and for standard training sessions is noticeable. As the project is developed, each phase and the design principles will be evaluated, modified and tried again.

References

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