

# The Use of Information and Communication Technologies (ICT) in Education: Two Profiles from the Pacific

By  
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In 2003, Pacific Resources for Education and Learning (PREL) contributed seven country profiles to UNESCO's *Meta-Survey on the Use of Technologies in Education in Asia and the Pacific*. This article presents two of those profiles, focusing on the use of Information and Communication Technologies (ICTs) in education in the Federated States of Micronesia (FSM) and the Republic of Palau.

## FEDERATED STATES OF MICRONESIA

### National Policies, Strategies, and Programs

The responsibility for education in the FSM is shared between the national government and the individual states of Chuuk, Kosrae, Pohnpei, and Yap. The FSM has a strategic plan to provide overall guidance for improving education in the country. However, the states have the primary responsibility for instruction, with the national government providing support and assistance. As a result, the individual states also have their own plans for the improvement of education and for the use of ICT.

Free public education is provided for children through the completion of grade 8 or age 15. High school attendance is based on passing a high school entrance examination.

Funding for education in the FSM is primarily provided through Compact funds provided by the U.S., with a significant amount also provided under U.S. federal education programs. The U.S. regards the FSM National Department of Education as a state education agency (SEA) and each of the state departments of education as local education agencies

(LEAs). The majority of funding under these programs is delivered directly to the individual states. The country has experienced a reduction in the amount of funding provided during the past several years, which has negatively impacted their ability to meet the educational needs of students.

The FSM supports one institution of higher education, the College of Micronesia—FSM (COM-FSM) with a national campus in Pohnpei and state campuses in each of the states. The COM-FSM offers associate's degrees and also has a third year program in education. The University of Guam works with the COM-FSM to provide the additional courses needed for a bachelor's degree in education on its campus in Guam and via distance learning. In addition, San Diego State University (SDSU) and other universities provide distance learning courses in the FSM.

Well-trained teachers are essential for the development of an effective education system in the FSM, and the national government has recognized the need to improve teacher training. Currently, approximately 85% of the teaching staff have less than a bachelor's degree and a substantial percentage have only a high school degree. Significant efforts have been made to increase professional development opportunities for teachers through distance learning technologies. PRELSTAR: A Pacific Islands Distance Learning Program and the Pacific Regional Technology in Education Consortium (PR\*TEC), funded by the U.S. Department of Education and managed by PREL, have provided both distance learning and face-to-face in-service and preservice training for teachers as well as training of faculty at the COM-FSM in the development and delivery of distance learning courses. However, substantial additional funding will be required to meet the needs of the country (Cantero, 1997).

The FSM has recognized the importance of data driven decision making in education. One of the goals in its strategic plan is to develop "appropriate assessment and evaluation systems for all levels of education and will use those systems as the basis for decision making, resource allocation, and planning and development" (Cantero, 1997, p. 37). Through the

U.S. funded Territories and Freely Associated States Education Grant Program (T&FASEGP), staff from the states and the national government have developed a database of information on education in the individual states as part of this effort.

The national and state governments also recognize the need to improve telecommunications access throughout the country and to develop effective information management and communication systems. However, the costs of upgrading this access and extending it to schools throughout the four states will require substantial outside funding both for the initial infrastructure investment and for ongoing recurring costs. Until this funding is identified, the governments will not be able to significantly improve telecommunications access to schools.

The strategic plan specifically addresses the need to develop a technology literate population. The main goal in this area is “to develop a technology literate population to rapidly respond to changing conditions in the world economy” through the following five objectives:

- Provide quality mathematics and science programs to form the basis for understanding and using current and future technologies.
- Develop student computer literacy for understanding and use of information technologies.
- Develop operational plans for effective use of the Internet and other information technologies for improvement of instructional and support staff training programs.
- Provide for repair and maintenance and upgrading of technological resources.
- Allocate financial and technical resources for assistive technologies (Cantero, 1997, p. 71).

### Current Level of ICT Access and Use

A total of 195 schools located on islands and atolls across an ocean expanse greater than the area of the continental United States serve approximately 34,179 children in the FSM. Of these schools, 74 have less than 100 students and 43 have less than 50 students. Most of these small schools are located in remote outer islands.

Telecommunications and power are not available on all islands or to all schools (see Table 1).

TABLE 1  
Schools and Accessibility

State	Schools with Power	Schools Accessible from DOE by			
		Auto	Boat	Ocean Ship	Small Plane
Kosrae	87.5%	87.5%	12.5%		
Pohnpei	75.0%	82.5%	5.0%	12.5%	
Chuuk	17.3%	18.4%	51.0%	31.6%	
Yap	40.0%	40.0%		60.0%	31.0%
Total	37.6%	39.8%	29.3%	31.5%	6.1%

The FSM Telecommunications Corporation (FSM Telecom) became an Internet Service Provider (ISP) in December 1996. Phone and Internet service are available to schools on the major islands of Chuuk, Kosrae, Pohnpei, and Yap and on the outer island of Ulithi in Yap State. However, the cost of bandwidth is high and not all schools are connected.

FSM Telecom operates a reliable fiber/copper ring system and Nortel digital switch on the four major islands. Internet service is also provided on these islands and the company has steadily increased the bandwidth available. Long distance phone calls to and from states in FSM currently cost \$1.00–\$2.00 per minute; direct Internet access is available at a cost of \$19.95 per month for 10 hours of service, with additional hours charged at \$1.95 per hour.

Flat-rate symmetric and asymmetric leased circuits are also available on the main islands. The cost of these services ranges from \$1,150 per month for 64 kbps of dedicated bandwidth to \$18,350 per month for 1,536 kbps. Unfortunately, the high cost of on- and off-island services limits the abilities of the departments of education to provide Internet access to students in schools. Where such access is provided, the schools must restrict use due to limited bandwidth.

The COM-FSM has a 512 kbs connection to the Internet through FSM Telecom that provides access for the national campus and all four state campuses. It manages the bandwidth among the campuses through Cisco routers. PREL, through its PRELSTAR program, and the University of Hawai‘i, through its Pan-Pacific Education and Communications Experiments by Satellite (PEACESAT) project, have collaborated to provide a 128 kbps videoconference network serving the COM-FSM and each of the state departments of education. This network connects with the PEACESAT bridge in Honolulu, Hawai‘i, and is available for use by the education, health, and government sectors.

Outer islands with schools and health dispensaries generally rely on high-frequency/single sideband (HF/SSB) radios. In Chuuk, for instance, 75% of students attend schools with

only this type of access. Future plans to serve the outer islands include the installation of a very small aperture terminal (VSAT) network attached to a wireless local loop (WLL) directly connected to FSM Telecom's digital switch.

At the school level, ICT access varies widely. Computer labs are operating at the main schools in Weno, Chuuk, including Iras and Sabok Elementary and Weno, Chuuk, and Xavier High Schools. In Kosrae and Pohnpei, computer labs are also operating in most schools. On the main island of Yap, all schools are connected through the Yap Department of Education (DOE) wide area network (WAN). This network uses microwave technology to connect all schools. The Yap DOE is also deploying wireless connectivity at some schools and maintains a computer lab at its offices for use by students and teachers. Computer labs are available at most schools on Yap and on most of Yap's outer islands, including Ulithi, Wolei, and Satawal.

Distance education is increasingly being used by organizations in the education and health sectors. The COM-FSM, DOEs, PREL, SDSU, the University of Guam, the University of Hawai'i, and other educational businesses are using distance education to provide teacher training in the FSM. The U.S. Army uses distance technologies to provide medical diagnosis, evaluation, and training, and the Centers for Disease Control and Prevention and the Health Resources and Services Administration use the infrastructure to deliver program updates. The technologies used range from online courses designed for low-bandwidth access to courses using synchronous videoconferencing, videos, traditional print, and various hybrid forms of media.

### Major Initiatives

Despite the high cost of telecommunications access, the low level of teacher training, the lack of funding, and the different approaches developed by the four states toward the integration of technology into the curriculum, the past 5 years has seen an increase in the local telecommunications infrastructure and in the use of technology in the schools.

For example, Yap has made significant progress in providing teacher training in technology integration. Through the efforts of the former Director of Education and his Director of Technology, computer laboratories were installed in most schools, a WAN was developed connecting schools on the main island, a state-of-the-art "smart" classroom was installed at Yap DOE headquarters for use in teacher training, and Internet access was extended to Ulithi. Local DOE staff leveraged the resources provided by PREL, PEACESAT, and various private and federal grants to engage both students and teachers in using technology. Learning materials, including early childhood books in Yapese, were developed, as well as art education and Web design courses for high school students.

Despite this progress, however, the lack of a strategic plan integrating technology into the curriculum has prevented the Yap DOE from realizing the full potential of ICT in education. Curriculum developers and technology staff often worked independently of each other. Some of the curriculum developers had a lack of understanding of educational technology or even basic technology applications and some of the technology staff had a lack of understanding of curriculum development.

The COM-FSM has also made significant progress in integrating technology into its curriculum and in extending educational opportunities by forming strategic alliances with other colleges and universities to improve and extend course offerings through distance learning. It is currently working with SDSU to provide courses for students and with PREL and other institutions of higher education in the region to develop a series of six basic 300- and 400-level courses for teachers with an associate's degree who are working toward a bachelor's degree. The college has also been providing professional development to teachers in local schools under a grant from the U.S. Department of Education.

From 2001 to 2003, PREL, in collaboration with Western Illinois University, offered a master's degree program in instructional technology and telecommunications. The program was designed to train a cadre of educational leaders from the region in instructional technology. One student from each of the four state departments of education and the manager of the COM-FSM's technology department participated. Three of these five participants completed the coursework and earned their master's degrees (one was forced to drop out due to a serious health problem and one was unable to handle the heavy course workload). These leaders are now working within their local DOEs on the integration of educational technology into the curriculum.

For the past 2 years, the University of Guam has received funding from the Sasakawa Pacific Island Nations Fund (SPINF) to assist the FSM states in developing distance learning plans. Each state has developed a distance learning plan to address the needs of education, health, and government. (These plans are available at [www.demicro.org](http://www.demicro.org).) The University of Guam has coordinated its activities in this project with those activities of PREL and the University of Hawai'i to provide coordinated assistance and training in the development of these plans as well as regularly scheduled teacher training workshops throughout the FSM.

A major initiative is currently being tested to improve telecommunications to remote islands through the use of satellite broadcast. This system has been designed to provide low-cost telecommunication links to islands with only HF/SSB radio communications. Using a combination of solar powered receivers, computers, and printers, the link provides low speed (9,600 bps) data broadcast throughout FSM. If the initial tests are successful, this network will allow FSM DOEs to deliver printed material to some of their most remote schools.

## Examples of Training

Individual departments of education, the COM-FSM, PREL, the University of Hawai'i, the University of Guam, and other organizations have provided training to teachers in the FSM. The individual DOEs have provided a number of workshops, often in collaboration with an institution of higher education or one of the regional service providers. The COM-FSM has developed basic ICT training for inclusion in its degree programs.

PREL is working closely with each of the DOEs in training trainers and teachers in the integration of technology into the classroom. This training focuses on integrating application skills into the curriculum and linking the National Educational Technology Standards (NETS), developed by the International Society for Technology in Education (ISTE), to local curriculum standards. These standards use an integrated, problem-based approach to developing unit and lesson plans incorporating technology. The step-by-step instructions and examples provided in the ISTE materials are particularly useful in working with teachers in the FSM who have little or no experience in developing lesson plans.

Ongoing ICT training is being provided through a 21st Century Community Technology Center grant to DOE staff in Pohnpei and through PREL and the University of Hawai'i to DOE staff in all four states. A CD and other support materials are being developed and delivered to operators of the video-conference network in an attempt to improve the availability of the network. Training is provided face-to-face, through videoconferencing, and online.

## Constraints on the Use of ICT

The lack of affordable telecommunications access is a major constraint on the use of ICT in the FSM. Each of the distance learning plans for the individual states highlights this as a barrier to the integration of ICT into the curriculum. The costs of providing this telecommunications access in the FSM are among the highest in the world because of the country's geographical remoteness and small population. The market is just not large enough to bear the initial and recurring costs of providing the service.

Second, the DOEs within the FSM are facing severe financial pressures. The reduction in funding under the Compact of Free Association with the U.S. has resulted in a lack of funding for basic hardware and software as well as for required improvements in classrooms or computer labs. Some departments are unable to provide power to schools on a continuous basis. The poor physical condition of many schools results in damage to computers. In addition, the high humidity and salt air of these islands significantly reduces the life of

computers unless they are kept in a controlled, air-conditioned environment.

Third, the level of teacher education in the FSM is low. As noted earlier, 85% of the teachers in the FSM do not have a bachelor's degree and more than 30% have only a high school diploma. With the current pay scale and physical conditions of the schools, it will be difficult to attract qualified teachers or to require current teachers to continue their formal education.

Finally, all of the training materials available are in English and designed for use with teachers who have a higher level of education, access to a wide variety of resources, and high proficiency in English. As a result, it is often difficult for teachers in the FSM to relate to these materials or to understand the language used.

## Analysis

The past 5 years has seen a marked increase in the use of ICT in the FSM. However, significant further improvement depends on the expansion of the ICT infrastructure, a reduction in bandwidth costs, additional funding for education, and improved education and training of teachers.

The FSM cannot afford major investments in ICT infrastructure to remote regions or sustain the ongoing costs of providing that service. Unless bandwidth costs are substantially reduced, students will continue to have very limited, if any, access to ICT. The technology to maximize the efficient use of bandwidth is already being deployed by the COM-FSM and the Yap DOE, but there still remains a need to increase the bandwidth available for their users.

A small amount of assistance to schools for telecommunications access would greatly increase the use of ICT in the FSM. In the U.S., the E-rate program provides a subsidy to schools for telecommunications access and has greatly increased the use of ICT by making access more affordable. A similar program, funded by outside sources, would facilitate the use of ICT in FSM.

The increased use of ICT will also require additional funding for physical improvements to schools, hardware and software purchases, and teacher training. The physical condition of computer labs must be upgraded to protect and extend the life of the equipment. Teacher training in the integration of technology into the curriculum should be ongoing using both face-to-face and distance learning technologies. A training plan should be developed for each of the departments of education to provide for this ongoing training of teachers. However, the plan can only succeed with dedicated funding.

## REPUBLIC OF PALAU

### National Policies, Strategies, and Programs

The Republic of Palau is an independent island nation located 500 miles southeast of the Philippines and 900 miles west of Guam. A former UN Trust Territory of the United States, Palau gained its independence in 1994, entering into a Compact of Free Association with the United States. As a result of the Compact, Palauan citizens use U.S. currency and have unrestricted travel privileges throughout the U.S. and its territories. Although Palau is a 400-mile-long archipelago with hundreds of islands (most uninhabited), the bulk of its 19,000 populace is located on the capital island of Koror. Because Palau's population is dispersed over several island groups, however, communication options can be limited for those living outside of Koror and the immediate area. While Palau is a young nation, it has a strong ICT infrastructure and several telecommunication options, although these are limited due to the remoteness of the island groups and lack of satellite availability. As part of the national technology plan of Palau, every person is to receive access to telecommunication, regardless of their location. The national telecom company, Palau National Communication Corporation (PNCC), has aggressively pursued this goal, resulting in the highest per capita penetration rates in the Pacific, with services including phone (landline and cellular), Internet, and television.

The two languages of Palau are Palauan and English. Japanese is widely spoken as well, as Japan administered Palau until the end of World War II and has a large tourism and fishing interest in the country. Public education is mandated for the ages of 6 through 16. Grades are modeled after the American system, with primary school consisting of grades 1–8, and high school consisting of grades 9–12.

Throughout the islands of Palau, there are 22 public elementary schools, 1 public high school, 2 private elementary schools, and 5 private high schools. There is also one institution of higher education, Palau Community College (PCC), which offers 2-year associate's degrees and a variety of vocational education and adult education opportunities. PCC is also partnered with several universities, including SDSU and the University of Guam, which allows students to pursue bachelor's, master's, and doctorate degrees without having to leave Palau (or by leaving only for limited amounts of time during the summer).

### Current Level of ICT Access and Use

In 2001, Pacific Learning Services (PLS) reported that Palau had a high level of computer penetration in all of its 23 public schools, with an average of 11 students per computer.

Technology and technology literacy are considered high priorities of the Ministry of Education (MOE), and as a result every school has at least one computer lab and a computer lab manager. Teacher training in technology literacy has been ongoing and mandatory for all teachers. However, computer labs remain underutilized and many are limited to use for drill-and-practice programs or games (PLS, 2001). In response, the MOE has been aggressively pursuing new training programs for teachers and has drafted an educational technology plan designed to address teacher deficiencies in technology literacy and basic technology skills, as well as provide guidelines for technology programs and integration into curriculum. These initiatives have resulted in increased usage of computers and technology integration across multiple disciplines, but low-bandwidth Internet access continues to pose a problem for schools.

The majority of computers in Palau schools use the Apple Macintosh platform. Windows platform computers are mostly limited to MOE administration staff, PCC, and high school business classes. The MOE has videoconferencing capability and utilizes the system to communicate with Hawai'i and other U.S. affiliates on a regular basis for professional development and administrative meetings. Two videoconferencing units are also in remote schools, but as they work through PNCC instead of the MOE's satellite-based system, operating costs are too high to warrant usage. To date, the two units remain functional, but not in operation.

Remote schools also have computer access. Most of the remote island groups have, at a minimum, semi-regular power that allows for the operation of computer labs. The very remote island groups rely on solar power for computer access. Internet and other telecommunication services, however, are limited or nonexistent in these islands.

### Major Initiatives

*The Teaching, Learning, Technology Training Project* was designed not only to bring technology to the students and teachers of Palau, but also to bring new strategies for teaching and learning. Building on the Palau 2000 Master Plan for Education Improvement, the project used a curriculum integration model that encourages student-to-student and student-to-teacher interactions, a model in which the mimetic approach to education gives way to a constructivist approach. The expectation was that through these changes a learning environment would be created that prepared students to deal with uncertainty, complexity, information resources, new technologies, and different cultures.

The training was designed and conducted by a consultant from Guam and required a significant commitment from those who enrolled. Initially, participants took part in an intensive weeklong program in Koror, followed by monthly daylong

sessions over a period of 6 months or longer. Through the training, teachers were exposed to a broad overview of computer operation, maintenance, and use in the classroom. Content addressed included the operation of specific software products (e.g., HyperStudio, KidPix) and various strategies related to integration and use (e.g., lesson planning, cooperative learning).

Under the Teaching, Learning, Technology Training Project, a framework for professional development for teachers and school principals was developed as a process intended to improve skills, attitudes, understanding, and performance. The process was structured around a series of courses/institutes designed for teachers to acquire identified skills and then apply and evaluate them using a problem solving/sharing approach. The courses/institutes were used, and continue to be used, as opportunities for teachers to discuss, think about, try out, and hone new practices. This form of professional development was key to the successful use of technology in education for improved student achievement.

The following technology competencies were identified as critical components of this professional development process: technology awareness, technology identification and operation, applications, academic skills development, cognitive skills development, acquisition of information (research), presentation/production skills, interpretation skills, ethics, and technology in the community.

These technology competencies were aligned with five stages of technology application, derived from the Apple Classroom of Tomorrow (ACOT) research studies, through which it was hoped all of Palau's teachers would pass.

- Entry stage—Teachers struggle with the changes education technologies bring to the classroom environment. They are required to rethink teaching and learning styles, develop a new technology vocabulary, and investigate new tools for learning. Initial experiences with technology characterize this first stage of technology awareness.
- Adoption stage—The struggle regarding acceptance of these new technologies is replaced by the struggle to master them at the most rudimentary levels. Fear is replaced by experimentation with electronic applications that closely imitate existing classroom activities, such as drill-and-practice and tutorial environments.
- Adaptation stage—Teachers recognize the potential and power of technology tools to the extent that they use them for personal productivity and begin to advance student usage of these same tools. Examples include the usage of word processing in writing assignments, databases in social studies research and data collection, and spreadsheet integration into the math and science curriculum.
- Appropriation stage—Teachers master specific technology applications and seamlessly integrate them into

daily instructional and management activities within the school environment. Teachers at this stage are a valuable resource to their colleagues. They help implement the “teacher-training-teacher” and mentoring models for professional development activities.

- Invention stage—Teachers are technologically proficient and provide students with necessary technology skills and access to these powerful resources. Teachers at this stage can develop sharable courseware and materials that link technologies to current curriculum or education reform components while they teach technology to others.

Each of these stages was linked to curriculum integration so teachers could select appropriate instructional activities relative to their existing skill set and professional growth plans. As professional development took place and teachers began integrating technology, they were expected to progress through each stage over an extended period. The phasing-in of the professional development offerings at all stages of integration was expected to result in the majority of teachers reaching the invention stage. Structured teacher training programs continue to be regularly offered by the MOE and teachers are encouraged to enroll.

*PRELSTAR: U.S. Federal Star Schools Project.* Through PRELSTAR, the MOE and Emergency Management System were able to connect to the PEACESAT satellite network with 128MB videoconferencing capability. This allowed the MOE to connect (free of charge) to a multitude of other sites across the U.S.-affiliated Pacific (including Hawai'i, Guam, the Commonwealth of the Northern Mariana Islands, and American Samoa). This system also allowed Palau to connect to any other videoconferencing system throughout the world via a relay system in Hawai'i (at a cost). PRELSTAR also provided training.

*PR\*TEC: U.S. Federal Regional Technology Consortia Project.* PR\*TEC provided technical training and support through PREL and assisted the MOE in a variety of technical training. Major initiatives included providing support and guidance in the formalization of a Palau Technology Education Plan to include technology standards and benchmarks for students, teachers, and administrators, and creating a Basic Teaching Credential that teachers can receive via distance technology. A current problem for the MOE is the lack of qualified teachers. This program, a collaborative effort with PCC and other public institutions of higher learning in the U.S.-affiliated Pacific, allows teachers to stay employed and on-island while taking courses toward certification.

*Sasakawa Peace Foundation.* The Sasakawa Peace Foundation of Japan has funded a number of technology and distance learning studies through the University of Hawai'i and the University of Guam. Grant awards have allowed both universities to convene meetings for the former Trust

Territories of the United States (Palau, the FSM, and the Republic of the Marshall Islands). These meetings and various reports have resulted in technical infrastructure data, needs assessments, and distance learning plans for each island nation.

*University of Guam: U.S. Department of Agriculture Challenge Grant.* Through a grant from the U.S. Department of Agriculture, the University of Guam, in partnership with local institutions of higher learning and Florida A&M University, have created a series of distance learning programs designed to assist agriculture teachers across the former Trust Territories of the United States. A series of modules were produced in both online and CD-ROM format and offered for university credit. The result is for participants to be trained in science and agriculture methods to improve both curriculums.

### Examples of Training

As part of its Compact of Free Association with the United States, Palau is entitled to participate in many U.S. federal grants and programs. These have allowed the MOE to vastly expand its services to teachers. Two major programs are provided through PREL, a Pacific-based, nonprofit education corporation.

The first, PRELSTAR, is a distance learning program designed to build telecommunication capacity in the U.S.-affiliated Pacific. PRELSTAR has provided distance learning training to teachers, administrators, government, and health workers for more than 5 years. Areas of training have included how to set up and maintain satellite earth stations, Internet usage for education and health purposes, videoconferencing training, educational and health distance learning programs, and computer/media troubleshooting and repair. The result has been an increased capacity of education and health workers to access ICT services. PRELSTAR also funded a distance learning master's program for the U.S.-affiliated Pacific in instructional technology. The result was two professionally trained instructional designers to assist MOE and PCC teachers with technology integration.

The second program provided through PREL is PR\*TEC. Like PRELSTAR, PR\*TEC offers distance learning training and support, but also provides technology literacy training for teachers and students, technology policy assistance, and computer repair programs. Work for the past 3 years of PR\*TEC in Palau has resulted in computer lab managers trained in integrating technology into the curriculum and repairing computers, a draft technology plan for the MOE, and technology standards for teachers, students, and administrators of the MOE.

### Constraints on the Use of ICT

*Limited Access to Internet.* The MOE's current telecommunications infrastructure is limited by the high cost of telecommunications within Palau and by the capacity of that infrastructure to support broadband services to schools. While schools have access to computers and other technology, only some have dial-up Internet access. They dial in to the MOE through a 6-modem modem bank. From there, the MOE is connected via a 64 kbps dedicated connection to the PNCC. This level of service limits each school to no more than three concurrent users. As a result, technology use in schools is limited to those activities that do not require Internet access. According to PLS (2001), these activities involve the preparation of lesson plans by teachers and papers and reports by students. Only a relatively small number of teachers are using computers, laser discs, or projectors as part of their instruction. Thus, few teachers have integrated technology into their instructional practices; instead they rely on the computer for drill-and-practice programs or for classroom management activities, such as grade books and class lists.

*Limited Bandwidth Capacity.* The PNCC is currently the only provider of telecommunications services in Palau. It has an Internet link that provides only 2 mbps downlink and 768 kbps uplink capacity. Although the company has installed a caching server, traffic on the link runs at 80-90% capacity. At peak periods of the day, the link appears to be completely saturated, resulting in the inability to access services or very slow response times when service is available. Though a fiber ring connecting Koror with the largest island of Babeldaob provides increased service, it too is running near capacity.

To increase bandwidth capacity, Palau is currently pursuing funding for a fiber cable to link Palau with the FSM's Yap State and the U.S. territory of Guam. High-level agreements are in place and preliminary planning is being conducted by NTT, a Japanese telecommunications company. The estimated costs for laying the cable begin at between \$50 and \$60 million. Cable maintenance costs are estimated at \$750,000 per year plus \$35,000 for each day the cable maintenance ship is at sea. In addition, there are considerable start-up costs. No funding for this project has been secured to date and the PNCC estimates that operating costs alone would require a 6-fold growth in the company's revenue base.

*Bandwidth for Schools.* The use of ICT to support education requires broadband Internet access. A full T1 access would best serve the needs of the MOE, but the cost of such access would require significant outside funding. The most cost-effective design for providing Internet access to schools involves the collaboration of the MOE with the PNCC and/or other ISPs to establish a WAN connecting schools with the MOE, a caching server at the MOE, and dedicated Internet bandwidth of at least 512 kbps from the MOE to the ISP. The use of a caching server will lessen bandwidth demands and

provide faster response times for Internet sites accessed by multiple users. This architecture will allow for future upgrades in Internet connectivity as additional bandwidth becomes available.

### Analysis

While Palau is far above the norm for computer access in education for the Pacific, the MOE would still like increased Internet access, a smaller computer-to-student ratio, higher technology literacy for teachers and students, and technology integration into the curriculum. To accomplish these goals, the following recommendations may be considered.

*ICT Access.* Palau telecommunication infrastructure is currently under the monopoly of the PNCC. Under the current universal access plan, the high rates of the PNCC for subscribers actually subsidize the very high operating costs of providing services to remote areas of Palau. Because of this, there is a private company is considering offering ICT services with its own teleport to bring additional bandwidth to Palau and concentrate on the main population center of Koror. This would provide lower-cost, high-speed Internet access to the largest amount of the populace. If this were to happen, the current model of universal access in Palau would be disrupted, as many customers would opt for the higher speed and cheaper cost of the private company.

A benefit for the MOE, however, would be better Internet access for the administration and schools. The lower costs would also allow them to purchase more computers under the same budget, as the money previously spent on Internet access could be redirected to equipment.

*Technology Literacy for Teachers and Students.* Under the current technology plan for the Palau MOE, technology literacy has been defined and categorized. However, to implement a plan that will ensure technology literacy for all students and teachers, time must be allocated for staff development for teachers and benchmarks must be assigned for students at each grade level. Technology literacy is a building process and should be consistent for students and teachers. Teachers must have a clear understanding of what is required to be technologically literate and be provided ample professional development opportunities to achieve it.

*Technology Integration.* Technology integration differs from technology literacy: the latter refers to specific skills, while the former refers to the application of those skills in different disciplines. Professional development opportunities for teachers should be provided on how to integrate technology into different subject areas, such as math, science, Palauan, and English. Computer access should also be provided.

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