Palau Ministry of Education
Executive Summary

Student Consultant, Zixuan Ma
Community Partner, Edwel Ongrung

I. Background Information

The Ministry of Education (MOE) is one of the eight ministries in the government executive branch. It is charged with the education of Palau's children and runs the public school system. Its mission statement is:

> *The mission of the Republic of Palau's Ministry of Education, in partnership with parents and community, is to ensure that our children and youth preserve Palauan culture and become contributing citizens and productive workers in a changing world. This will establish a high quality of life and security for future generations of Palauans.*

The Ministry of Education is constantly improving its organization operations in order to serve generations of Palauan students and parents effectively. In particular, they are receptive to new technology and are looking for ways to incorporate technology to increase the effectiveness of management, administration and instruction.

II. Consulting Tasks

PHS's only public high school, Palau High School (PHS), is administered by MOE. The management team at MOE is aware that PHS needs an upgrade in its student information system. They are particularly concerned about the delays of transcript generation at the end of each school year. Keizy Shiro, the PHS registrar, have requested from MOE several times for technical help as the databases at PHS is gradually becoming unmanageable. The student consultant is tasked to resolve the transcripts by redesigning the student information system at PHS.

At the same time, MOE has also identified some areas the public school system can enrich their teaching with the use of web-based applications. Edwel Ongrung, the technical lead for MOE, is considering the use of learning management systems (LMS) as an instructional tool for teachers. In addition, LMS is useful for MOE's day-to-day operations as they can serve as a simple file repository for non-technical staff. The student consultant is asked to explore the different LMS, highlight its features and determine if they meet the organizational needs.

III. Outcomes Analysis and Recommendations

The transcript delay at PHS is part of a bigger database management problem. In order to effectively solve the problem, a database redesign is needed since the databases are small and a redesign will expand the possible uses of the database.

A new database design was implemented at PHS and it consists of well-defined relational tables. The transcripts are now automatically generated instead of manually filled in from the database. Apart from the transcripts, the new database is capable for other uses as well. Attendance taking, for example, was done solely in paper but now it can be easily incorporated into the system. The reports from the old databases such as class scheduling and report card continue to function with additional features.

Because of the new database implementation, MOE and PHS now have a common database format that allows easy data transfers. This means less duplicate data entry work in both organizations, thus increasing data integrity. In addition, PHS can leverage the MOE web expertise to create a web interface for their student information system in the future.

The new database design and format is the most critical component of the student information system. However, without proper maintenance and backups, the system can quickly become obsolete. MOE should invest in proper database training for the technical team to ensure the system is sustainable and its uses expanded.

For the adoption of LMS at MOE and the schools, the student consultant has identified a LMS that fits the technical profile of MOE. The LMS, Moodle, is currently installed on a MOE server and is synced with their existing authentication system. At present, Edwel is using Moodle as a file repository for MOE's ongoing projects.

In addition, Moodle was introduced to a handful of teachers from the public schools and they were enthusiastic about what a LMS can offer. Some teachers intend to try out Moodle during the school year to evaluate if it is indeed a useful instructional tool. However, to realize the full benefits of an LMS, MOE needs to establish a reliable network between MOE and the schools.

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Palau Ministry of Education
Final Consulting Report

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I. About the Organization

Organization

The Republic of Palau's Ministry of Education (MOE) is responsible for maintaining a high level of education throughout the nation's public school system. To satisfy this responsibility the ministry reviews and recommends funding, curriculum and personnel changes and develops educational plans and budgets to submit to the national government. The school system consists of twenty-two public elementary schools (grades 1-8) and one public high school (grades 9-12). Overall, the school system comprises 2200 students at the elementary level and approximately 750 students at the high school level. Almost half of the students in grades 1-8 attend the two schools in the State of Koror, Koror Elementary and George B. Harris Elementary.

The ministry is a branch of the Republic of Palau's national government and is overseen by a politically appointed minister. The organizational structure consists of a Director of Education reporting to the Minister, followed by four Chiefs each responsible for a division plus an Administrative Services Manager.

Most of the funding for the MOE comes from the national government of Palau, however they also receive grant money from the US Department of Education and assistance from Pacific Resources for Education and Learning, a non-profit based in Hawaii dedicated to improving education in the region. Because of the diversity of sources providing funds, the MOE must follow guidelines required by the different bodies, including the U.S.'s No Child Left Behind Act.

The Administrative Services division is responsible for the technical environment. It consists of a manager, Edwel Ongrung, and a four person staff. This department works with the other divisions within the Ministry to provide the services necessary to support the mission of each division. These services include computer and network installation and support, software deployment and information services.

Facilities

The MOE is housed in its own building in the center of Koror. There is ample space for the Administrative Services department. There is secure, air-conditioned space for servers and networking equipment.

There are also computer labs in each of the public schools in Palau. For the most part, there are individual labs to house these computers. Access is limited to teachers and students and security has not been an issue.

Programs

The ministry maintains all of the public schools in the country. They handle transportation, facilities, supplies, staff, curriculum development, and instructional technology. All of the upper level staff principals and administrators have email and utilize it frequently as their primary means of communication. There is a plan to expand this email accesses to all students and staff. Teachers intend to use internet research to enrich existing curriculum in both high school and primary school.

Staff

The head of the ministry is the Minister of Education Mario Katosang who's appointed by the elected government. The ministry has one bureau and the Director of Education Emery Wenty runs the day-to-day of the bureau. Alongside in the organization chart are four chiefs that form the management team responsible for making decisions the guide the ministries activities. The four chiefs are:

- Sinton Soalablai. Chief, Division of School Management.
- Teodoro Rengulbai. Chief, Division of Personnel Management.
- Raynold Mechol. Chief, Division of Research and Evaluation.
- Debbie Tkel Sbal. Chief, Division of Curriculum.

Technical Environment

The technical environment is extensive, the management of it all runs through Edwel and he has a technical staff of 3 people who work with him and handle all the maintenance, management, setup of the computers. The average school has as a baseline a lab of around 1 computer for every 3 to 5 students. These computers ranged from old Power Macs as the low-end and old iMacs seem to be the midrange but some labs were stocked with machines that were ordered within the last 6 months. Aside from Palau High School, which is on a 10MBit wireless connection, most schools have dialup 33.6 kbps accesses. The management team is responsible for the technology planning. The minister makes the final decision on the suggestion of the management team. The management develops technical solutions to the problems facing the ministry.

Technical Management and Planning

The Administrative Services division is responsible for the planning and management of technology. The management team (consisting of the Minister, Director and four Chiefs) must approve all official changes in policy and while a technology plan has been developed, it has not yet been approved. Even without that approval however, many aspects of the plan are being implemented and the organization has a clear direction and focus for future technical development.

Internal and External Communication

The organization must communicate on several different levels. Within the Ministry there is extensive use of the MOE email system. The management team meets frequently to discuss the direction of the organization and with everyone centrally located communication is not an issue. The MOE must also keep an open dialogue

with schools throughout Palau. All school principals are provided with an Apple laptop and officials at each school have been assigned email addresses. The majority of principals are comfortable using email as a means of communication.

The elementary schools are regularly required to submit various forms with statistical information such as enrollment, attendance and grades. Most schools submit these forms electronically via email, but occasionally they are delivered on paper and the information must manually be typed. There is also an issue regarding file formats since many of the schools uses AppleWorks while the MOE works with Microsoft Office. Currently the technical team is in the process of standardizing the file formats and software that are used as well as moving towards a web-based interface for data entry and reporting. They have a clear preference for open-source software since such software is easily maintainable and can be upgraded at little or no cost.

School staff regularly attends professional development courses at the MOE and these sessions serve as the primary means of communicating information to teachers in Palau. The teachers are very interested in technology but at the same time they have limited exposure to computers. To help spread the use of technology and computer, MOE has some key technological integration staff in the various schools to promote the use of computers among teachers and students.

There is currently little communication between the students and parents and the MOE. Grades and other information are sent to the parents directly by the schools. There is a realization within the MOE that as information becomes more centrally located, new procedures may have to be adopted.

Information Management

Information management has consistently been one of the most significant challenges posed to the MOE. There is a remarkable amount of data and organizing it efficiently and generating accurate and appropriate reports from it has proven to be a difficult task. The MOE has resorted to numerous contrasting systems for different components of information management with mixed success.

The Ministry has had the most success with handling financial and staff data. In the last year, a successful transition has been made from a FileMaker database to a MySQL/PHP based system. Several databases store information such as the budget, current staff, salary data and timecard reports. Employees keep this information up to date through a PHP interface designed by Edwel Ongrung.

The MOE has had significantly less success managing student data. A variety of solutions have been attempted, but none has provided the up to date information and reporting that the organization requires. A Microsoft Access database was designed to record student enrollment data and generates reports, but there was difficulty in its implementation as there was no efficient way to input data into the system. Only one MOE employee could perform data entry and data did not arrive from the schools in a consistent or useful format. This method has been abandoned in favor of Microsoft Excel spreadsheets, but many of the same problems remain concerning data entry. Often by the time information is entered into the spreadsheets, it is already obsolete. A HTML web form system was designed two years ago to retrieve data from the

schools in a consistent format, but policy did not dictate its use, and although training was provided for the teachers, the system never gained acceptance or overall use.

II. Scope of Work

Task 1. Improve Palau High School Student Information System

Palau High School (PHS) currently has 2 types of Access databases that are used to store student Information: one for storing class scheduling information and another that stores student report card information. They are maintained by the PHS registrar Keizy Shiro.

The class scheduling database stores information about room assignments as well as teachers' and students' class schedules. This information is usually entered at the start of each school year. Keizy developed the database forms as well as the database tables to help him with his job.

The data stored in the class scheduling database is replaced yearly and is not archived for future reference. In other words, the information about the class schedules for the previous years are deleted when the school year rolls over.

The student report card database stores information about the students' grades. The teachers will give the students' grades to Keizy in paper and he will enter the grades at the end of each semester (2 semester/school year). Using this information, Keizy can generate useful reports such as honor roll, a list of borderline students and student transcripts. This database was designed by Edwel Ongrung from MOE Administrative Services.

The data stored in the report card database is archived for future reference. This is particularly important for creating transcripts for students who has already graduated as well as providing statistical reports to MOE. For each school year, a new report card database is created and the databases from previous years are archived.

The class scheduling database and the student report card database are separate databases. Thus, each database maintains its own table of student records and class schedules.

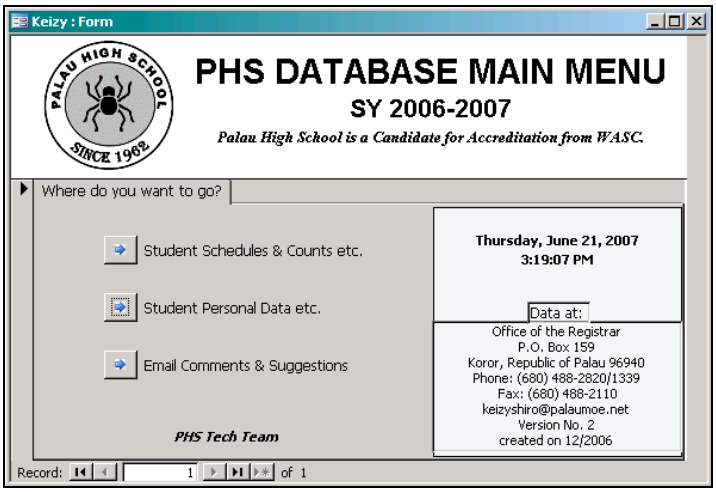


Figure 1: Class scheduling database form. It allows the PHS registrar enter room assignments and class schedule information

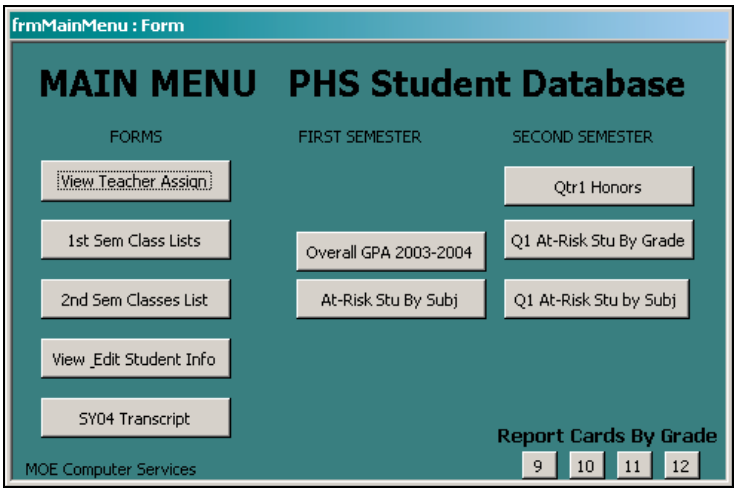


Figure 2: Student report card database form. It allows the PHS registrar to enter students' grade and generate useful reports.

There are several problems associated with these databases:

- **The databases are poorly designed.** The current databases are poorly designed in several ways. First, Keizy has to create a student scheduling and a report card database for each school year. This is both inefficient and unmanageable in the long run because there will be many isolated databases with no easy way of comparing information (e.g. comparing the percentage of graduating students in 2005 to that of 2006). This however can be resolved by creating a single database to contain all the student scheduling/report card information.

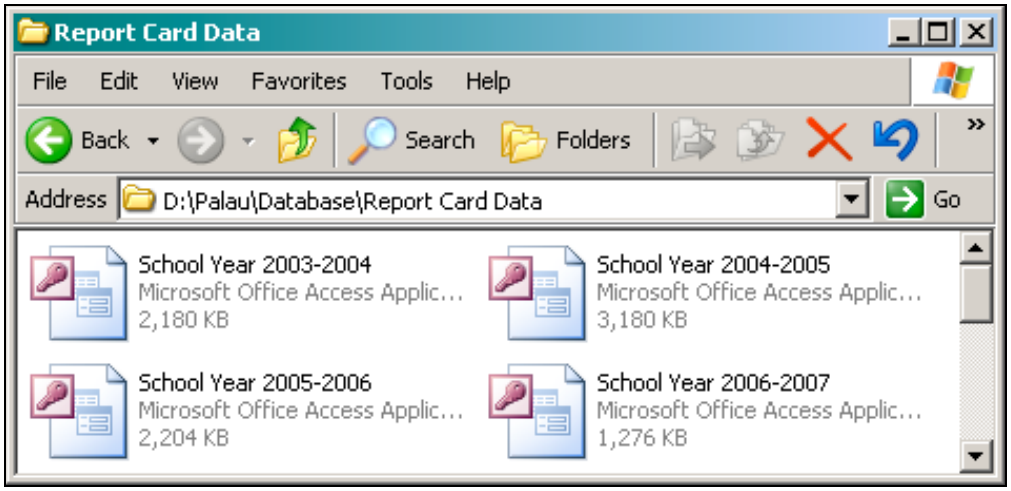
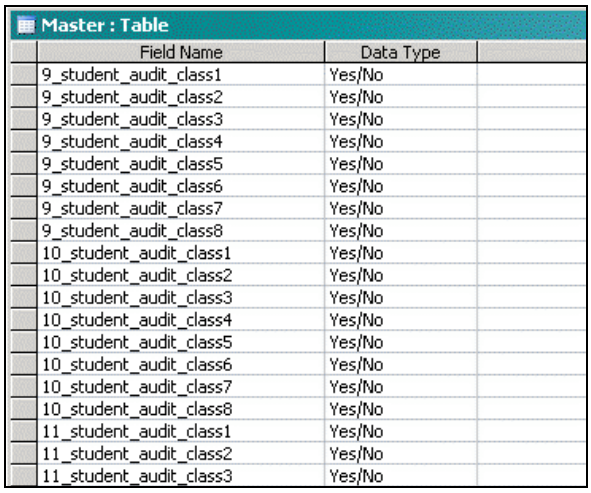


Figure 3: One database per school year. The PHS registrar has to create new databases each year.

Second, the databases have excessive number of fields. For example, in the scheduling database, the table that stores students' personal information also stores if a student is auditing for a class for each period, term, semester and grade. As a result, there are 64 such binary fields (4 grades, 2 semesters, 2 terms and 4 periods) in the table. This information can be more efficiently stored as records in a new table for easy updating and maintenance.



Master : Table

Field Name	Data Type
9_student_audit_class1	Yes/No
9_student_audit_class2	Yes/No
9_student_audit_class3	Yes/No
9_student_audit_class4	Yes/No
9_student_audit_class5	Yes/No
9_student_audit_class6	Yes/No
9_student_audit_class7	Yes/No
9_student_audit_class8	Yes/No
10_student_audit_class1	Yes/No
10_student_audit_class2	Yes/No
10_student_audit_class3	Yes/No
10_student_audit_class4	Yes/No
10_student_audit_class5	Yes/No
10_student_audit_class6	Yes/No
10_student_audit_class7	Yes/No
10_student_audit_class8	Yes/No
11_student_audit_class1	Yes/No
11_student_audit_class2	Yes/No
11_student_audit_class3	Yes/No

Figure 4: Excessive number of fields. Such information can be more efficiently stored in a new table as records.

Thirdly, the tables in the database are either defunct or not properly maintained. There are some fields in tables that are empty for all records. The default values, primary keys and table relations are also not well-defined.

A database redesign would resolve most of the database inefficiencies. A better understanding of the purpose of each database, table, field and their relations is needed to maintain these databases in the long run. In the process, Keizy will learn about database design and how to extend it in the future.

- **Databases have duplicate information.** The class scheduling database and the student report card database have duplicate information such as student personal information and students' class schedule. Since the two types of database are unrelated, Keizy needs to enter the data twice into the separate databases for each school year. This is a time-consuming process which can be simplified by combining the two databases into one.

- **Databases have integrity problems.** As the data needs to be entered twice, the information stored in each database tends to be inconsistent. The database forms for each database also stores and access information in a slightly different manner (e.g. storing name fields with initials and in full and storing course names in upper and lower cases). Furthermore, there is no mechanism to check for data integrity in both databases besides manual inspection. Currently, the number of students, courses and teachers in each database do not agree. These problems can be averted with well-defined table relations and good form design.

- **Databases are not utilized to automate report generation.** At presently, Keizy generates student transcripts and audit forms (forms to determine if a student can promote or graduate) by reading student information from the database forms and manually transfer them to a Microsoft Word template for printing. This process can be expedited by creating a new database form based on the Word template or use the mail merge feature in Word to automatically generate reports.

- **Databases are incompatible with MOE's databases.** The Ministry of Education currently maintains a list of students from 1st to 8th grade in their MySQL databases. It has plans to extend this database to include those from PHS such that students that are promoted from the 8th grade to the 9th grade are automatically enrolled into the PHS students' list. This would greatly simplify Keizy's job as he would only need to manually enter information for students outside of the Palau education system.

  However, since PHS uses Microsoft Access and MOE uses MySQL, the different database systems can hinder such integration. Keizy and Edwel want the Access back-end databases to be ported over to MySQL while Keizy is still able access them using Access front-end forms. This will not only simplify Keizy's job without learning to use new forms but it will also provide additional security as Keizy would not have carry the confidential Access databases on his portable devices.

  One available solution is to use the Open Database Connectivity (ODBC) protocol that allows easy interaction between different database systems. This solution is a very database-specific as it requires choosing compatible data types between databases.

The consultant will work with Keizy and Edwel to build the new, centralized database. Keizy will be involved in construction of the new database so that she can maintain and extend the databases when the consultant leaves.

Expected Outcomes

Activity	Expected Outcome	How to Measure	Current Measure	Evidence of Change
Review all current databases and forms with Keizy	Understand what info to be captured; Know intended use of data	Consultant has good understanding of each form and associated database	Consultant have moderate understanding of each form; have not worked with databases	Consultants completely understand forms and how they fit with each database
Design a new database that incorporates both report card and scheduling databases	A single database for both scheduling and report card	Keizy's understanding of good database design and how the two databases can be combined into one	Keizy have separate databases for scheduling and report cards	Keizy knows how to create queries and reports for the one new database
Design Microsoft Access databases such that it is compatible with MySQL data structures	Portable database design between Access and MySQL using ODBC	Microsoft Access front-end forms accesses and updates database in Access or MySQL correctly	Microsoft Access front-end forms accesses and updates database in Access correctly	Keizy no longer carry copies of Access databases on portable devices Integrating with Palau High School database with MOE MySQL databases
Import data from existing database to new database	Data from the existing databases are imported to the new database	Database front-end forms works with a single database Database is consistent for both scheduling and grading	Database front-end forms works with multiple databases Data integrity issues with multiple databases	Keizy no longer maintains more than one database
Generate transcript automatically using mail-merge or database forms	Keizy can generate transcripts automatically by selected the student, year or grade level	Student information is automatically filled in on transcript form	Student information is manually entered from database	Palau High School has little delay when generating transcripts at the end of the school year

Additional Impacts

Expected impacts to the overall organization are as follows:

- **Transcripts processing** – The management team at MOE is concerned that transcripts from PHS is often delayed and this caused problems for student admission into PCC and other US universities. With the use of automatic transcript generation, the delay will be reduced significantly.

- **Technical Management –** Since Keizy will have a better understanding of database design, it should be easier for him to create new queries, reports, and databases when necessary. Thus, if in the future PHS needs to store information about students' meal plan or other school programs, Keizy will be equipped with the skills to extend the databases.

- **Staff training** – Keizy's current job scope is to enter data into the system and to produce transcripts when needed. However, if the databases are updated using the MOE's database and the transcripts are generated automatically, Keizy's job scope could be transformed to train other employees to perform database maintenance and help other schools design their database systems.

- **Information Management** – One of the main goals of having a good database design is to reduce data integrity and redundancy problems. Keizy is concerned about the accuracy of the student transcripts as it affects their job or college applications. The new database design will enable accurate data reporting and also consistent data storage for each student throughout their education in Palau

Feasibility

This project is considered feasible through an analysis of requirements, risks, and sustainability.

Requirements:

Time. This project can be completed during the partnership, requiring around 3 to 4 weeks. Because the requirements for the central database can be gathered from the existing database and forms, there is much less analysis required.

Motivation. Keizy is particularly motivated for this project, because he is tired of entering the same information twice into the system. The management team in MOE is particular concern about the delay in transcripts and eagerly wants to resolve the problem.

Resources. The project is planned as an Access database with compatible data types with MySQL.

Skills. One consultant is skilled in database design and can work to learn to use Access. Keizy already has a good amount of Access experience and mail merge in Word which will serve as a foundation to build upon.

Risks:

Forms and existing databases more complicated than expected. Combining a series of existing databases which intersect could become complicated. This problem is exacerbated by small details such as the lack of addresses in Palau. In addition, combining two separate databases might be more complicated than it seems as the separate database forms uses these information differently.

Importing existing data into new database. As just described, the existing databases may have intersecting data stored in slightly different ways. It will probably be difficult to import the data into the new database, and it will probably require a good amount of data entry time.

Learning Access. It is possible, though unlikely, that the consultants will not be able to learn the required reporting, querying, and form features of Access. To offset this risk, the consultant will work closely with Keizy who has extensive experience with Access.

Sustainability:

The work is expected to be sustainable because much of the project is about teaching Keizy about good database design. Keizy is particularly eager to learn as he picked up Access using the Internet and created his own database application to help him store the class schedules. With the additional knowledge about designing database, Keizy would be able to understand how his forms work with the new database and how he can extend it in the future.

Task 2. Learning management software (LMS) adoption

PHS currently uses a mixed of conventional teaching methods such as whiteboard and markers and computers such as the Multimedia Assisted Instruction Laboratory (MAI Lab) to achieve their instructional objectives. The MAI Lab is maintained by the lab manager Romalda D. Emesiochel.

Besides PHS, Kuror Elementary School (KES) also uses computers extensively in their instruction. At present, KES is exploring the use of K12 Linux Terminal Server Project (K12LTSP) in their computer labs. It uses several thin clients as terminals and a central server for processing. The K12LTSP system is cheap and easy to administer as the thin clients are essentially dumb terminals. Joyce is the lab manager for KES.

There are several problems associated with the use of computers in these settings:

- **PHS teachers do not utilized the MAI Lab.** The MAI Lab is part of PHS instructional tool but it is not utilized by the teachers effectively. During computer lessons, the teacher would often leave the students in the lab and leave the lab as he/she is unfamiliar with technology. The lab manager is then forced to maintain order in the lab for the teacher without providing them instructions.

  The students' learning experience is limited by how much the teacher utilizes the MAI Lab. The MAI Labs can potentially equip students with useful computer skills and help them learn their course materials in a multimedia way.

  The use of LMS can better equip teachers to teach courses using technology. If teachers can see the benefits for themselves and the students, it can help automate some of their jobs such as grading and enriched the learning experience for students. Students would also be able to gain valuable IT skills through LMS.

- **KES teachers needs to access student assignments effectively.** Teachers and students at KES use computers to issue and complete assignment respectively. When the students complete their assignments, they have no way to submit to the teachers as they do not have email accounts.

- To grade the assignments, the teachers collect a list of login names and password of all their students. They would then manually login as a student for each student to gain access to the completed assignments. For the students, this is not only a loss of privacy but it is also a security breach. The students' clear text passwords are easily accessible and there have been reports of computer misuse due to unauthorized logins. For the teachers, this is a time-consuming process.

- Joyce wants to fine-tune the access controls for the teachers and students. There are many possible tools such as the use of shared directories between users. However, a LMS is a better choice in this case. It can not only provide roles management for teachers and students, it also serves as an excellent tool to store grades, provide feedback and discuss about assignments.

- **There is no repository for course materials.** At both PHS and KES, because there is a lack of tools for collaboration, there is little or no exchange of course information between teachers. At the same time, there is a lack of repository to store the course materials as a back up and as a reusable knowledge base for new teachers.

  Thus, while each teacher might have a good way of teaching students, there is no collective intelligence in instruction. As such, the schools failed to capture the valuable teaching experiences that teachers gain over time.

  At MOE, Edwel has set a goal for his technical team to move all of the stand-alone applications to network-based applications. To do this, his staff needs to continually learn new skills such as deploying Linux systems, configuring security settings for web applications and creating the database back-end to support such systems. While doing so, he would like to create an information repository to document the process.

  Edwel mentioned the problem with using emails to solve technical problems. Over time, email conversations can get lost and the knowledge gain through the emails or other forms of communication is not archived. However, he sees that an online forum is a way to archive such knowledge and get faster help. In addition, he sees the potential use of Wikis to create different projects and get the latest update easily.

  A LMS provides all the tools that PHS, KES and MOE needs. It works as a bundled application that allows the use of forums, Wikis and a file repository. This will simplify the administrative effort to maintain a single system instead of 3 separate systems.

The consultant will work with Edwel to install a learning management system on the MOE's server. This system will be used by the technical team as a repository for their projects. The consultant will also work with the IT maintenance personnel to ensure they will be able to upgrade and maintain the LMS when the consultant leaves.

Expected Outcomes

Activity	Expected Outcome	How to Measure	Current Measure	Evidence of Change
Explore a suitable LMS	An LMS that is feasible to deploy on MOE's existing servers and it meets the functional needs for teachers and students	LMS contains features that helps improve instruction in PHS, MOE and KES	There is no LMS deployed The MAI Labs is underutilized	A LMS that is being deployed at MOE and accessible from PHS and KES
Deploy LMS on MOE's servers	A LMS that is ready to be used by the teachers and students	Users can successfully login to the LMS Users can upload/download course materials	There is no LMS currently deployed	LMS is available to students and teachers within the MOE network
Introduce LMS to teachers	Teachers knows about the benefits of using a LMS	Teachers understands how LMS can be used as an instructional tool	There is no LMS currently deployed	Teachers will gradually learn to use technology when they can see the benefits

Additional Impacts

Expected impacts to the overall organization are as follows:

- **Enhanced learning experience** – The management team at MOE is concerned that transcripts from PHS is often delayed and this caused problems for student admission into PCC and other US universities. With the use of automatic transcript generation, the delay will be reduced significantly.

- **Technology adoption –** If the use of LMS encourages teachers and students to use technology, it would have a broader impact on the school system as a whole. The use of email as a primary communication tool might become the norm. The registrars in schools might no longer have to input grades manually as they are sent electronically as a CSV file via email.

Feasibility

This project is considered feasible through an analysis of requirements, risks, and sustainability.

Requirements:

Time. The initial research for a suitable LMS is completed in week 1 and the selected LMS is currently deployed within MOE. As an ongoing project till August, the technical team in MOE and Joyce will test out the LMS to determine its usefulness. The consultant will provide technical and user help and these information will be documented on the LMS.

Motivation. KES and MOE are keen in implementing LMS to solve their problems and needs. On the other hand, the management team in MOE feels that the teachers in PHS are not ready to learn a new system. The infrastructure and accessibility of computers in PHS limits the usefulness of a learning management tool. Furthermore, there are more pressing issues such as database problems and transcripts delays that need to be addressed first.

In any case, if the LMS is proven useful in MOE, the technical team can conduct training sessions for future LMS deployment in other schools.

Training. The pilot users and the consultant should be heavily involved in using the LMS. As frequent users, we should be able to identify some of the common difficulties that most users encounter.

Skills. Various LMS uses different programming languages and supports a range databases. The chosen LMS is programmed in PHP and uses a MySQL database. Although the consultant is unfamiliar with PHP, the program does not require any code tweaks. To offset this risk, the technical staff in MOE has a good understanding of PHP and they can provide some help if needed.

Risks:

The benefits of the LMS are overrated. The consultant had provided a demonstration to Edwel and the management team on how to use the various features of the LMS and they all agreed that it is a useful instructional tool. However, as actual users of the system, the LMS might end up being more cumbersome than helpful. However, from the many success stories of using LMS, this risk is minimal and users would tend to find the benefits outweigh the costs.

The LMS might require excessive hardware resources if fully deployed. At present, there are 3 courses deployed on the LMS and there are 3 users. However, as the system gets deployed on a larger scale, the hardware requirements for the system might increase significantly and new hardware will be needed. However, with the proper settings on the LMS such as limiting file upload sizes, this risk can be averted.

Importing course materials to LMS may be difficult. While it is relatively easy to upload a file to a website, it is often harder to digitize physical course materials and upload them to the LMS. There are generally 2 ways of entering such information: digitally scanning the physical materials or manually entering the data into the system. Both are time-consuming processes, with the latter being much slower. These processes would probably need additional manpower to ensure that the course materials are successfully uploaded.

Sustainability:

The work is expected to be sustainable as Edwel, Joyce and the management team in MOE agreed that LMS is a great instructional tool and they just need the proper training and assistance. For the management team at MOE, it is only a matter of finding the appropriate time to deploy it at PHS. Overall, the use of LMS will transform the way lessons are taught in Palau.

III. Outcomes and Recommendations

Task 1. Improve Palau High School's Student Information System

Here are some of the outcomes of the consulting process:

- **Designed a new database.** Through the consulting process, Keizy and the student consultant discussed and identified what are the needs of PHS. Keizy is extremely busy with administrative work during the school year. As a result, he often looks for immediate solutions for his problems rather than looking at the bigger problems in the student information system.

  One of the biggest problems with the database, apart from the problems listed in Part II, is that the information is stored in a student-centric way. This means that it is easy to retrieve student information such as their grades, scheduling, family information and enrollment as the entire database consists of only one flat table. On the other hand, because the database is student-centric, it is difficult to retrieve information about teachers, classes, room availability, course prerequisites and aggregate information.

  The new database no longer consists of one flat table but several smaller tables that are connected and restricted by relationships. This means information about classes, courses, teachers, rooms and students are stored in a way that allows information to be retrieved based on the users' needs.

  In addition, the new database also solves the problems highlighted in Part II. There will be no data integrity problem or duplicate information as there are no longer multiple databases to worry about. The new database design also has primary key, foreign key and relationship constraints built in such that it forbids erroneous information to be entered.

  The new database is the first step of consolidating all the information from the past years such that Keizy can easily produce useful statistics for MOE and automated report generation for the students. This would help the ministry better understand the needs of PHS and the PHS administration can serve the student body and staff more efficiently.

  Keizy has a brief understanding of how the database works. He understands the relationships between tables but he is unable to create queries on his own initially. On the other hand, he is extremely comfortable with the PivotTable function in Excel as well as the forms in Access. The student consultant has worked with him how to create queries based on the information he needs (e.g. find the number of enrollment for each grade in 2007). Keizy can now create some queries to get the data he needs and use Excel or Access to generate useful reports.

  On the other hand, there are some queries that are difficult to create (e.g. find the number of repeated students in 2007) and Keizy is unable to easily retrieve such information as before when he was using a flat database. There is a moderate risk of sustainability as he needs to get used to relational databases, learn more about Structured Query Language (SQL) and apply

these concepts to a database that he does not fully understand. Edwel can help Keizy in this transitional phase as he has extensive experience with SQL.

- **Created a MySQL back-end database** The preferred database that PHS uses is Microsoft Access while MOE prefers MySQL. The different database formats slows down the process of information exchange between MOE and PHS. At the end of each school year, MOE will produce a list of all the 8th grade students that are promoted to 9th grade and pass it to PHS. At the same time, PHS needs to produce aggregate information about the school's performance for MOE. This process can be simplified if they both used a common database format.

  Edwel and the student consultant have agreed that MySQL is a good common database format for both PHS and MOE. For MOE, Edwel currently have all their inventory, staff and program information stored in MySQL servers. They also have the 1st to 8th grade student information for all the elementary schools. For PHS, they prefer to use Microsoft Access because Keizy can create front-end forms easily. If MySQL is used in PHS, Keizy still can continue to use Microsoft Access forms and connect to MySQL via Open Database Connectivity (ODBC).

  After understanding PHS data entry and reporting needs, a relational database was created with well-defined primary-foreign key constraints as well as value constraints (e.g. default/null/non-null values). This is a crucial feature of the new database as the old scheduling database had a flat table with little or no value constraints while the report card database has some form of primary-foreign key relationships but some of the relationships are broken because of null values in the primary keys. The student consultant also created unique indices (e.g. no teacher can teach two classes in the same room, period, semester and school year) to ensure that erroneous data cannot be entered accidentally.

  This database setup will facilitate the statistical reporting from PHS to MOE and also school year rollover from 8th grade to 9th grade at PHS. Edwel has plans to create queries to automatically update/access the PHS database at the end of each school year. This will reduce the amount of data entry/retrieval Keizy needs to do at the beginning of each school year. At the same time, this setup will eliminate any data integrity problems due to manual information exchange from PHS to MOE and vice versa.

  MOE has a clear direction to move all applications to a web interface. Thus, with the use of a MySQL database at PHS, Edwel and the technical team can easily create a PHP web interface for PHS. This would be particularly useful for PHS students in the future where they can view their grades online, modify their personal information and register for classes using a web browser. This would require additional infrastructure such as Secure Socket Layer (SSL) to ensure data confidentiality.

- **Created new Access front-end forms** Besides creating the database back-end, Keizy and the student consultant worked together to create the database front-end in Microsoft Access. The existing database front-end created by Edwel and Keizy both uses the Access controls in a basic way. There were little error-checking mechanism such as defining the format for date fields and restricting the values in a drop-down menu. Without these error-checking

mechanisms, a casual user could enter illegal values (e.g. 99/99/9999 for a date field) and they can cause serious data integrity problems as seen in the old databases.

The new database forms are connected to the MySQL back-end via ODBC. As such, the front-end forms are aware of the indices and constraints that are created on the back-end. In addition, Microsoft Access also provides an easy way to restrict values and check for illegal format by changing the properties of the form controls or adding program code using Visual Basic for Applications (VBA). All these checks will ensure that erroneous information will not be entered into the database.

Besides error-checking, Keizy also needed that the forms to display useful information that will assist him in data entry. For example, when entering the class schedules for students, Keizy would like to know if a student has already earned the credit for the course or if he/she meets the prerequisite to the take the course. He would also like to know if a class has been overbook as the room capacity might not be big enough to accommodate all the students. The new forms contain such information as warnings if any prerequisite is violated or a class is overbooked.

Such class information can be easily retrieved from the new database and displayed on forms. Using the old database, Keizy tend to overbook classes or assign a class that a student has already earned a credit for as class information cannot be retrieved easily. As a result, Keizy would have to make several scheduling changes at the beginning of each school year when the students report such errors to him.

Using the new database, there has been no report of scheduling conflicts for the current school year. During the first week of the school year where students can make changes to the schedule, Keizy has only encountered class changes due to teacher or class preferences. At the same time, Keizy does not want the classes to exceed 25 students per class. Thus, when he receives class change requests, he can better advise students using the class information if such changes can be allowed. This is one example of how the database forms are assisting Keizy to focus more on his administrative work and better serve the students and teachers.

In the process of creating these customized forms for PHS, the forms get complicated gradually with more error-checking and information that is displayed on the form. As a result, the final form contains a moderate amount of VBA code. Although Keizy has some experience with VBA, he is not very comfortable programming as it is a tedious process. Furthermore, his assistant Romalda will most likely be replacing him in the near future but she does not have any programming experience in Access or VBA. Thus, sustainability may be an issue as Keizy and Romalda might not have the technical skills to make changes to the forms when needed. On the other hand, this risk can be mitigated since Keizy knows how to create new basic error-checking forms without complicated VBA code that produces additional information.

- **Importing data from old databases to new database** The old databases contains duplicate student and scheduling information and these information needs to be consolidated such that Keizy will only need to maintain one database and it can be used for generating reports such as transcripts. The new database now contains all the information from the various report card and scheduling databases from the past four years.

The process of consolidating the data was a painstaking and error-prone process. The student, course and teacher names used varied slightly from database to database and such data can only be correlated using manual inspection. Some databases have missing information because of the lack of format constraints and data restrictions in data entry.

Because the data is consolidated manually, Keizy and the student consultant have an understanding that the old data in the new database is subjected to errors. Keizy randomly compared some of the report card data from the new database with that of the old database and they are consistent. At the same time, he has also discovered a student who has transferred out in 2003 and another student who was a freshmen in 2003 both shared one set of student information because they had the same name. Thus, while Keizy can enter new data accurately into the database, it is less certain if the old student information can be just as reliable. To ensure that Palau High School will continue to produce accurate report card and transcripts for graduated students, Keizy will still rely on the old databases for the time being.

- **Automated report generation** The MOE management team was motivated to change the PHS student information system because they know of the transcript delays situation at the end of the school year. Graduating students often receive their transcripts late because the transcripts are created manually by reading off the information from the report card database. This is extremely problematic when students need to apply to foreign universities as they tend to have strict dateline for applications.

  The class schedules and report cards are already automatically generated prior to the new database design. This is easy to generate because all the class schedule and report card information are stored in a single database for each year. However, it was impossible to generate transcript easily as the transcript information for a student typically spans across 4 databases, with each database represent one school year. Thus, Keizy has been working with multiple databases for the past few years to generate transcript although it is inefficient.

  With the new database design and imported data from multiple databases, all the information needed to auto-generate a transcript is now stored in a single database. The student consultant has created an Access transcript report that is similar to the current transcript template in Word except that the student name, grades, credits and courses taken are automatically retrieved from the database. At the same time, Keizy will also have the option of modifying some information on the transcript such as the graduation date, number of semesters taken and rank in class.

  For the ranking of the students in the graduating class, Keizy used to copy all the data from Access into Excel and then use various aggregate functions to calculate the cumulative GPA and average score. He then sorts the students according to the GPA followed by the average score. After that, he determines who their valedictorian is for the school year as well as the ranking of all the students. This ranking process is now expedited because a single database allows the cumulative GPA and average score to be calculated using a SQL query.

  The new database can be utilized to automate other report generation such as audit forms. Audit forms are used in PHS at the end of the school year to determine if a student can graduate,

promote to the next grade level or have to be retained. Similar to the transcripts, Keizy produces such forms manually as he has to manage many databases. With the new database, he is able to automatically generate audit forms but it has not been tested if it can be useful. The new audit form created by the student consultant is very different from the old audit form and if he prefers, he will create his own audit forms. Thus, as a result of the consolidated database, Keizy can now consider automating report generation which was impossible in the past.

Keizy has used the automated transcript generation to produce transcripts for some students. He is quite comfortable with using the system. At present, most of the information is accurate but there are still risks of inaccurate information because of the database consolidation process.

- **Attendance** Keizy has intended to create a database to help the attendance registrar manage the absence information. He created a flat table database but gave up because it became too complicated. With the new database, the absence information is now stored in a table and useful reports can be generated.

  Prior to this school year, the attendance registrar records all attendance information manually. Everyday, the teacher for each class will submit an attendance sheet to the registrar. She has cabinets full of attendance sheets and from all these information she needs to call the parents of the students who are absent for three consecutive days. In addition, a student's parents might also call to ask how often the student is absent and she needs to look through all the paper to determine the absence number.

  In a separate process, the teacher for each class will also keep track of a student's attendance. The teachers need to do so because Keizy needs to be shown it to the parents on the report cards. The number of absences is submitted quarterly together with the quarter grades and Keizy enters them into the report card database. Some parents have complained about the absence count on the report card as it is inconsistent with what they have heard from the attendance registrar.

  As for the current year, the attendance recording process will be changed. The attendance registrar will record the attendance sheet everyday into the database and Keizy will count the number of absences for each student at the end of each quarter. The absence count is calculated automatically using a query. This will eliminate the task for the teachers to record attendance. At the same time, the attendance registrar can find the number of absence count from the start of the school year to the current date so as to answer any parents' inquiries.

  Keizy tried using the attendance system and it works fine. He will be training the attendance registrar on how to use the database form. Currently the form has a small bug that pops up a warning message whenever data is entered but the data entry is accurate. At present, Keizy is still requiring the teachers to keep track of the attendance as a backup plan if the attendance forms fail. Once the system is tried and tested, this database system will not only ease some workload from the teachers but it will also ensure data integrity in reporting.

- **Indirect outcomes** The new database provided Keizy some new insights about some of the reports he would like to create in the past but was unable to. In particular, he is now able to create a grade list for the teachers easily.

  In prior years, the scheduling and report card databases were separate databases. Before school starts, Keizy schedules the students to their classes in the scheduling databases. He then produces student schedules for the students and students' lists for teachers. He can also modify students' lists to create grade lists for teachers to record student scores. However, because the grade list will be used for the report card database, the grade lists often reveals the inconsistencies between the two databases and it is unsuitable for recording grades accurately. In the past, names of the students are manually filled in on a paper with a table (also known as the "long sheet"). With a single database, such problem will not exist as the data is stored in one location.

  There are some other database front-end forms that were created to facilitate Keizy's work. Firstly, there is a course called "Career Development I" that consists of 5 rotations per semester rather than 2 quarters. Thus, it requires 5 data entry boxes for scores rather than the usual 2. In the past, since there are only 2 data entry boxes, Keizy will take the average of the first 3 rotation scores and record it under the quarter 1 score and the average of the last 2 rotations are recorded as quarter 2 score. With the use of relational tables, a new table is created to store the scores of the 5 rotations and update the quarter scores using the appropriate weights. This will ease Keizy's work of calculating the averages manually.

  One additional feature that was added to the database was a recording of the books that students owe to PHS. It is written in the PHS handbook that if a student owes the school a textbook he or she would not be able to graduate. This rule is however not enforced because there is no easy way for Keizy to ensure that the student do not owe any books. Teachers will just submit a list of students that owe text books but Keizy was unable to enter the data into the old databases effectively. With the new database, there is a table that records if a student owes the school any textbook. Thus, Keizy can now check the table and withhold the transcripts of students who owe textbooks until their textbook obligations are fulfilled. This feature of the new database will help enforce the book rule but it is uncertain if Keizy will utilize it because he is not used to it.

  Apart from the database at PHS, Edwel has plans to use the database design to store all the student data for all elementary schools. He will modify the database design to insert a school identifier and because it is relational, he can add grade level into the enrollment table every year. This will help reduce data integrity problems when the school year rollover.

- **Understanding of relational database** The student consultant has conducted a couple of database training with the technical team at MOE, Keizy and some technical staff from the schools. The sessions are about 3 to 4 hours long and we discussed about how to extract information from a relational database using SQL queries. We did not cover conceptual materials such as ER diagrams and one-to-one relationships because the audience are not ready to learn such abstract material in such a short time but are more interested in hands-on activities. Edwel wanted the sessions to be an exposure to relational database but was not

intending for them to learn how to design and create a database. This is certainly a drawback in terms of sustainability because the technical staff is still unfamiliar on how to create relational databases.

Recommendations

Here are some recommendations for the consulting partner:

- **Training about relational database design** Edwel has a clear idea about relational database design and MOE can run more efficiently if he can teach the technical staff the basic ideas about relational database. It is crucial as the technical team is moving away from flat databases and towards relational databases because relational databases are more flexible and can be used to extract different information base on the users' needs.

  Databases are used to store data and they should be designed in such a way that it allows the required information to be extracted. Flat databases are usually restrictive since information is usually ordered in a particular order (e.g. Students in the PHS database). This means that the kind of statistical information that can be extracted from the database is limited to the order it was originally arranged (e.g. It is hard to find the average score for each class because it is ordered by class not student).

  The technical team, namely Tom and Warren, is mostly familiar with flat databases and they are comfortable using them to generate the required reports. However, if MOE continue to create and use flat databases as they are so used to, they will eventually face the problem of an inefficient database with the growing amount of data. Furthermore, if MOE hires an external company to build a relational database for them, it is inevitable that Tom and Warren would need to learn the concepts of relational databases in order to customize and maintain it.

  The most important reason for relational database is its ease to manipulate data for statistical reporting. Statistics are usually part of funding justification for certain projects. If the technical team is able to use relational databases instead of flat databases, they can produce some creative and useful statistics about the state of MOE and justify the needs for certain projects.

- **Data maintenance personnel at PHS** Keizy Data entry at PHS consists of mainly Keizy and 2 other ladies, Romalda and Nora. During busier times, Keizy will ask the teachers for help in data entry. While there are good data entry people at PHS, it is hard to find someone who is trained to maintain the database.

  Two years ago, the student information at PHS is manually processed. That changed when Keizy introduced a scheduling database and Edwel introduced a report card database. The processes are simplified and the position of registrar is created specially for Keizy. At this point, PHS is in a transitional phase of moving away from hardcopy data to softcopy data. As PHS becomes more dependent on databases, it is crucial that there are trained personnel to ensure the data is not corrupted.

  Currently, Keizy is the only person who is able to debug the database forms and understand the database design fully. Romalda and Nora are familiar with Excel but they have little experience

with Access. As such, when Keizy moves on to his next job position in the near future, the database at PHS will be left unmanaged. Romalda and Nora can enter information and print reports but they would be clueless on how to troubleshoot when the database goes awry. After the busy period at the start of the school year, Keizy should spend some time with Nora and Romalda to ensure they have a better understanding of Access and MySQL. At the very least, they should know how to backup and restore information. Romalda and Nora should not have a problem learning Access. Keizy has a good working relationship with them and they are both fast learners when it comes to technology. After Romalda and Nora are familiar with Access, they should be teaching some of the other school teachers that are helping out in data entry. This will ensure the database at PHS is maintainable in the long run and the student information system is sustainable.

Task 2. Learning management software (LMS) adoption

Here are some of the outcomes of the consulting process:

- **Moodle storage at MOE** After exploring some of the possible choice for learning management system, Edwel and the student consultant agreed that Moodle, an open-source LMS, is the most suitable software that meets the needs of MOE. Since most of MOE's web applications are based on PHP and MySQL, it is natural that we choose a LMS that is based on PHP and MySQL such that the technical team would not have to learn a new programming language or database to maintain it. In addition, Moodle has an easily customizable interface and it supports the Lightweight Directory Access Protocol (LDAP) which MOE uses for email authentication. In other words, all MOE staff do not need to remember another login name and password as they can login using their email credentials.

  A Moodle server is setup on the MOE internal network and it has been configured to use the LDAP server for authentication. Edwel has used it for some of his projects as a repository for files. Edwel understands the benefits of Moodle goes beyond a simple file repository and plans to use it in the future for his classes at PCC as well as sharing information with different people in MOE.

  The student consultant also used Moodle as an instructional tool when teaching his database sessions. The materials are all uploaded to the Moodle server and the technical team can continue to review the materials after the consultant leaves Palau. The technical team does not seem enthusiastic about Moodle, either because they are not used to the new system or the available materials on Moodle are uninteresting.

- **Introduction of Moodle to school teachers** During the 13th Educational Conference, the student consultant manage to introduce Moodle about twenty-five teachers in two sessions. The sessions were planned such that it only demonstrated the features of Moodle and not the how-to in Moodle. The responses to Moodle were overall very enthusiastic. Many teachers can see how they can use such a tool in their school and the MOE technical team can help set up a server if needed.

  Moodle is a complete package of tools that instructors can use for teaching. It moves the physical classroom into a virtual environment such that all communications are done

electronically. These include but no limited to homework assignments, quizzes, tests, forums, gradebook and course materials. The instructor can choose to utilize only the most useful features such that it enhances his or her teaching.

Most of the teachers are interested in the fact that quizzes are automatically graded and the grades are tabulated for all the registered students for a course. However, they do not know the trouble it takes to create a good quiz and provide automatic feedback for the students. During the preparation for the presentation, the student consultant spent about 1 to 2 hours preparing for two quizzes with four questions each. Thus, while the benefits of Moodle are clear, most teachers might resist this new technology as it is too time-consuming to use.

Two teachers from PHS have expressed a clear interest in Moodle. They plan to ask Edwel to create a course for them on the MOE server. Because of the close proximity of PHS and MOE, the teachers and students at PHS should be able to access Moodle without any significant delays. If these two courses are setup and prove to be a success among students and teachers, the use of Moodle might be more popular than expected.

Recommendation

Here are some recommendations for the consulting partner:

- **Improve Internet connection and computer availability** Moodle is an LMS that is used to facilitate student-teacher communication over the web. Thus, for the full benefits of Moodle to be realized, a good network infrastructure is needed to ensure teachers and students can access the required material when needed. The current MOE network can be improved such that Moodle will be an appealing option for the teachers.

  The Moodle server needs to be accessible at all times for teachers and students to use it effectively. If the server is frequently disrupted due to power outages or some other accidents, it will be difficult to convince even the most enthusiastic teacher to use Moodle. Besides Moodle, the MOE email is another important service that needs to be protected in order to increase adoption. A backup generator needs to be installed to ensure that such services are continually running in a predictable event such as a power outage.

  Besides power, the network reliability is another important factor for Moodle's success. A good network connection will allow teachers reliably delegate tasks on Moodle as he or she is sure that the students will receive it. Thus, it is important that the routers and switches are fixed quickly once they are reported faulty. This will ensure that students' online learning will not be hindered due to technical problems.

  The availability of computers to teachers and students is the key to the success of Moodle. One of the features of Moodle is that it allows students to learn even after class time. As such, if the students and teachers can get access to computers for a longer time, they would probably have more chances to be familiar with Moodle. The computer labs at the schools can be open for extended hours such that teachers and students have more opportunities to use computers. It will not only help them familiarized with Moodle but also with the use of computers in general for text editing, Internet and other software.

- **Evaluate Moodle using trial courses** From the Moodle sessions with the teachers, it is clear that teachers are enthusiastic about it. On the other hand, they might not use it because it requires a lot of additional training and learning. Thus, it will be better if MOE can work with some really interested teachers to create some courses and evaluate if Moodle is indeed a right tool for the Palau education system.

  The teachers at PHS are generally very open to new technology. Because of the close proximity of MOE and PHS, network access at PHS is much faster as compare to the other schools. It would be ideal that MOE conduct training workshops for some PHS teachers. They can create some courses, try to use it in class and see what the responses from the students are. If it is positive, it is then clear that Moodle can potentially be used in the other schools. If not, Moodle should be reevaluated and perhaps it is not the appropriate time to introduce such an application.

Additional Recommendations

The internal network at MOE and the public school is very well-connected and accessible to administrative staff as well as the teachers and students. Because of its accessibility, the servers at MOE are targets of malicious attacks by amateur student hackers or disgruntled employees within the organization. These attacks include denial-of-service (DoS), unauthorized intrusion and spam. Although the risk of such attacks is low, confidential and crucial information can be lost when the servers are disrupted.

The hostname "palaumoe.net" has been blacklisted by SpamHaus as a spam source. As a result, some email servers will identify messages from MOE as spam and filter them. For Edwel and other staff that rely heavily on email, the spam list is a nuisance because email is no longer a reliable communication means with the outside world. The technical team is in the process of resolving the inconvenience and at the same time MOE can take precautions against such events.

Login name and password are private information used to identify a user. If compromised, a malicious user could gain unauthorized access to confidential information. Some of the ways to protect user credentials include hashing passwords on servers, use Secure Socket Layer (SSL) for communications and encourage good security habits.

- Passwords stored on the servers should be hashed such that they cannot be viewed by anyone. This would prevent any password stealing (which can lead to impersonation or DoS) by technical staff or skilful hackers who have full privileges to servers.

- SSL is a security protocol often used by financial institution to encrypt bank transactions. In a similar way, MOE can protect users' credential by encrypting them over the network. If Moodle is eventually used in schools and quizzes are given online, SSL is compulsory to prevent hacking students from stealing information from the network.

  Open-source implementation of SSL such as OpenSSL is compatible with the MOE's email and web services. The key certificates should be self-signed to avoid costly certificates signed by third-party Certificate Authority (CA) such as VeriSign. This, however, may not be a feasible solution as SSL traffic will further burden the already overloaded network. SSL

implementation should only be considered after the network is upgraded to accommodate the higher volume encrypted traffic.

- Users on the MOE network needs to be educated about why login names and passwords should be kept confidential. Good practices such as not writing passwords on a paper or not sharing credentials with a friend for convenience should be advertised and encouraged. However, these solutions can be hard to implement as MOE employees tend to not remember their passwords and prefer to write it down.

  At the same time, users should change their passwords such that they contain a mixture of alphanumeric and special characters, have a minimum length and have a lock-out policy of 3 tries to protect against brute-force guessing attacks. Again, there is a risk of users not understanding the need of such practices and at the same time it might increase MOE's technical workload due to the overwhelming number of questions.

  Security education for the students and staff is important as they will affect not only the current generation but it will also create a culture that emphasizes on security in the future. Posters, workshops and policy enforcement (e.g. 3 tries lock-out) are some possible ways to promote security awareness in the MOE community.

About the Consultant

Zixuan Ma is a recent graduate from the Masters in Information Systems Management program at Carnegie Mellon University. He will be working at the Defence Science & Technology Agency in Singapore.