

# TECHNOLOGY CONSULTING

IN THE GLOBAL COMMUNITY

Final Consulting Report  
Palau Ministry of Education  
Yaxuan (Rebecca) Li  
August 2021

**Carnegie Mellon University**





## **Executive Summary**

Student Consultant, Yaxuan (Rebecca) Li  
Global Community Partner, Edwel Ongrung and Keizy Shiro

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### **I. About the Organization**

“Palau is a country located in the western Pacific Ocean. It consists of some 340 coral and volcanic islands perched on the Kyushu-Palau Ridge.”<sup>1</sup> Palau government has different branches. Among all of them, the Palau Ministry of Education (MOE) is responsible for providing the public education services and implementing the national educational curricula. It supervises the educational services for all the elementary schools and high schools, that include 17 elementary schools (grade 1-8) and 1 high school (grade 9-12) across the nation. The mission statement of the organization is

*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.*

The organization has a clear vision as follows,

*Our students will be successful in the Palauan society and the world.*

### **II. Provide cleaning tool to mark the problematic student results**

Ministry of Education staff currently cleans the unclear student results manually and sends back the problematic row number to Bureau of Curriculum and Instruction (BCI) for rescanning. The cleaning tool can loop through all the student results and check if the student ID, school ID and grade level match with the record in the database. Then, if all the variables match with the database, the cleaning tool will change the dependent variables like school name, student name, section, sex, and special education into the recorded information. If not all the variables match with the database, the information will stay the same and the tool will mark the problematic column for technical assistant to check manually. If the student ID, which is the primary key in this case, is missing, the row will be marked as bad data, which will be checked by the scanning person again.

#### **Outputs**

1. Cleaning tool written in Excel VBA
2. Training for staff with training guide

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<sup>1</sup> Foster, S. (2021) *Palau*. Retrieved from <https://www.britannica.com/place/Palau>

3. Description of the tools and major functions

#### **Outcomes**

1. Clean the student data efficiently
2. Easy to identify the problematic rows and columns
3. Easy to store the data in tsv and upload to the MySQL database

#### **Major Risks**

1. The students will graduate or move up one grade level after one year, so the analyst should keep the school list and student list updated.
2. Long-term maintenance and relevance of platform.
3. New staff might forget to check the guidance of the required data columns such as sequence number and the row for correct answers.

### **III. Provide analysis tool to analyze the test statistics**

Ministry of Education staff currently analyzes the test result manually by creating a graph for average score for all grade level. This analysis tool can create descriptive statistics including mean, median, mode, standard deviation, and skew. It can also create pass failed table and proficiency table for all grade levels. It also enables the comparison between pre and post PERA results to see if students make an improvement. The analyst is able to choose a specific school and generate the report as well.

#### **Outputs**

1. Analysis tool written in Excel VBA
2. Training for staff with training guide
3. Description of the tools and major functions

#### **Outcomes**

1. Generate the analysis efficiently
2. Easy to see the distribution of the students' performance in each objective
3. Easy to compare the pass and failed results across all the grade level

#### **Major Risks**

1. The function of analyzing individual school with fewer than 10 students is disabled, but smaller schools might also wish to enable this function in the future
2. The unequal number of students taken pre and post test will make the comparison not representative

### **IV. Provide charting tool to visualize the test statistics**

Ministry of Education staff currently manually generates the graph for average score for all grade level. This charting tool can create graph for mean and median across all the grade levels. It can create a pie chart for each grade level to visualize the percentage of passed and failed students. It can create proficiency chart for each grade level to visualize the performance of each standard.

#### **Outputs**

1. Charting tool written in Excel VBA

2. Training for staff with training guide
3. Description of the tools and major functions

### **Outcomes**

1. Generate the charts efficiently
2. Easy to see the statistics visualization
3. Easy to compare the pre and post PERA average score across all the grade level

### **Major Risks**

1. School level charting might be lack of student records
2. Long-term maintenance and relevance of platform

## **V. Additional Recommendations**

1. User testing the cleaning, analysis and charting tool using PERA 2021 results

### **Consulting Partner**

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### **About the Consultant**

Yaxuan (Rebecca) Li  
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Rebecca is a rising junior major in Information Systems and minor in Business Analytics and Optimization and Human Computer Interaction.

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### I. About the Organization

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#### Facilities

The Division of Research and Evaluation (DRE) is located in the main island. There are three buildings in the center offices, and DRE is in one of the buildings. There are 18 schools supervised by MOE, and the total number of students are 2,100. The largest one has 600 students and the smallest one has 7 students. In terms of public schools, 17 elementary schools, 1 high school consisting of 570 students. Each school has campus, but the number of buildings varies depending on the number of enrolled students and island population. All the elementary schools have the Samsung tablet for education purposes. The average temperature is around 81 degrees Fahrenheit. Nowadays, 30% of the classrooms have air-conditioning.

#### Programs

The Division of Research and Evaluation (DRE) assists the Bureau of Curriculum and Instruction (BCI) with the analysis and reporting the Palau English Reading Assessment (PERA).

BCI Education Specialists ensure that student answer sheets are complete and legible especially for students in grades 1-3. Then, they extract the data from the answer sheets into spreadsheet tables

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<sup>2</sup> Foster, S. (2021) *Palau*. Retrieved from <https://www.britannica.com/place/Palau>

and send the data and answer keys to DRE. The data extraction is done by optical mark recognition, a type of scanning used for answer sheet type tests.

DRE Assessment Specialists use Microsoft Excel to perform the analysis and generate tables of statistics. Unclean data will be returned back to BCI for manual check. Then, the data is stored in the database.

DRE Assessment Specialist, using the statistics tables, generates basic charts and graphs manually for each grade and school. Next, he forwards the statistics tables and charts and graphs to the BCI Education Specialists. A tool is needed to automate the process so the software could extract the clean data from the database, perform the analysis and generate the statistics tables and charts.

## Staff

There are five staffs that in charge of supervising the project, Mrs. Pillar Ngiraswei, Mr. Masubed Tkel, Mrs. Rilla Ngirmidol and Mr. Keizy Shiro from the Division of Research and Evaluation (DRE) and Mr. Edwel Ongrung from Ministry of Education (MOE). Mr.Keizy will be the primary contact for system requirements and Mr.Edwel Ongrung will assist with the product management throughout the project. Previously, Mr.Keizy used Microsoft Excel to perform the data cleaning and generate charts. Another student consultant is developing the cloud services so that crucial information will be back up in the cloud in the future.

## Technology Infrastructure

Technology Category	Description
Hardware	Server hardware managed by IT 90% MOE employees have the user hardware (laptop, desktop, tablets) provided by the ministry Every site has at least 2 printers, a copier machine, telephone system, Wi-Fi connection, a projector, blackboards.
Internet Connection	Provide 24/7 access for most schools except three remote schools. Those people communicate using single side band (SSB). Experience power outages sometimes
Operating Systems	Mostly Android, 90% of laptops are Mac OS, 10% are windows, in the server room, they run Linux
Database	MySQL
Website	The current website is built using HTML, CSS, JavaScript, PHP
Software Programs	Most people use Microsoft Office
Social Media	No official social media, but officials are looking forward to setting up one for the organization
Solar System	Generate 32 kw of electricity every day, the power goes into the

	grid and MOE got the power from there. The energy is part of the entire nation. MOE will get the distribution of solar power assigned by the units and pay the bills after the deduction of the available solar power.
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## **Technology Management and Planning**

Edwel Ongrung is responsible for managing the technology in Palau Ministry of Education and providing technical suggestions to DRE staffs. Another CMU student consultant is currently working on a project to initiate their first moves to the cloud. MOE will be looking into how the cloud manages its services going forward such as outsourcing, retaining someone on board to manage. MOE is considering formalizing the IT department by hiring someone taking care of and fixing any problems with the cloud services. At this point, they already had a website and MySQL in the cloud. Student performance data is stored in MySQL. In the future, the ministry of education is intended to store PERA results on MySQL. Right now, the testing results are stored locally in the DRE staff's computer. Each DRE staff can choose their preferred laptop, but they all use Microsoft Excel to organize the datasets.

There is no formal IT committee in MOE, but there is a lab manager in each school. In 2004, two of lab managers came to work with technology in MOE and Edwel is in charge of developing technology infrastructure.

Bureau of Curriculum and Instruction (BCI) has the budget to develop any desired applications. They could build instructional sites including technology. They could reach out to outside specialists to do the work. If they have problem with bandwidth, they normally reach out to IT department to minimize the cost at a discount rate with the telecom company.

## **Communication**

Email is the most commonly used way to communicate. If further explanations are needed, a zoom call will be set up. The exemplary student results and meeting notes will be shared via email. There is an official MOE website to update the new policies and technology. If MOE staffs want to know the email address for someone else in the organization, they could reach out to the IT manger. The primary means of communication is talking face-to-face and phone calls. The ministry is intended to implement remote learning platform on zoom to ensure more equitable access to educational resources.

There are 18 schools in the nation. Three of the schools are located in the nearby islands which are reachable using boats and three schools are located in remote school approximately 300 miles away from the main island, and it takes 12 hours to travel by ship and another 12 hours to the furthest island. The three remote islands do not have electricity, so they communicate using radio.

## **Information Management**

### Finance data

The Ministry of Finance is responsible for managing the budget throughout the Palau government using the commercial accounting system developed by a US company. MOE fills out form

electronically and print out the document just for signature, and it will be converted into electronic record by Ministry of Finance.

### Student data

One CMU consultant built an application student information system (SIS) in 2005, so that MOE can store the students' information in the database.

BCI Education Specialists extract the data from the answer sheets into spreadsheet tables and send the data to DRE in excel spreadsheet. The data extraction is done by optical mark recognition, a type of scanning used for answer sheet type tests.

DRE Assessment Specialists use Microsoft Excel to perform the analysis and generate tables of statistics. Unclean data will be returned back to BCI for manual check. Then, the data is stored in the database.

### **Business Systems**

Student consultants came to Palau in 2018 and 2019 to build an application for budget office to handle requisition. Ministry of Finance is in charge of managing payroll, but Ministry of Education is in charging of reporting timesheets to Ministry of Finance and instigate the paperwork. Division of personnel management is in charging recording employees' status electronically.

## **II. Provide cleaning tool to mark the problematic student results**

### **Motivation**

The Division of Research and Evaluation (DRE) Assessment Specialist used Microsoft Excel to perform analysis for the Palau English Reading Assessment (PERA) test results. However, the data is not clean, which means student names might be misspelled and important attributes like student ID and school ID are missing. The manual check by the Bureau of Curriculum (BCI) is not efficient enough, so a tool needs to be developed to mark the unclean data and store all of them in a separate spreadsheet.

Ministry of Education staff currently cleans the unclear student results manually and sends back the problematic row number to Bureau of Curriculum and Instruction (BCI) for rescanning. The cleaning tool can loop through all the student results and check if the student ID, school ID and grade level match with the record in the database. Then, if all the variables match with the database, the cleaning tool will change the dependent variables like school name, student name, section, sex, and special education into the recorded information. If not all the variables match with the database, the information will stay the same and the tool will mark the problematic column for technical assistant to check manually. If the student ID, which is the primary key in this case, is missing, the row will be marked as bad data, which will be checked by the scanning person again.

### **Outcomes**

The output was a cleaning tool written in Excel VBA. The outcomes of this new tool are as follows:

1. Correct the incorrect information by looping through all the student record and check if student ID, school ID and grade level all match with the database and check the dependent variables to avoid mis scanning
2. Mark the row without a readable student ID as problematic data



3. Mark the problematic column if not all the primary keys match with the database to enable the BCI staff check misinformation easily
4. Easy to store the corrected data in tsv and upload to the MySQL database
5. Easy to store the original data in tsv and upload to the MySQL database for backup proposes

The full set user stories for the cleaning tool is available at the appendix.

### **Recommendation**

To maintain the accuracy of the student database, the analyst should keep the school list and student list updated after each school year. Also, it is important for new analyst to look through the instruction of the cleaning tool before using. The tool is designed to create the new columns based on the specific number, so the sequence number as well as the row for correct answers is required.

## **III. Provide analysis tool to analyze the test statistics**

### **Motivation**

The DRE Assessment Specialist currently analyzes the test result manually by creating a graph for average score for all grade level. This analysis tool can create descriptive statistics including mean, median, mode, standard deviation, and skew. It can also create pass failed table and proficiency table for all grade levels. It also enables the comparison between pre and post PERA results to see if students make an improvement. The analyst can choose a specific school and generate the report as well.

### **Outcomes**

The output was an analysis tool written in Excel VBA. The outcomes of this new tool are as follows:

1. Download and open the tsv file of a given school year and school ID in excel worksheet.
2. All the data from grade 1 to grade 8 will be opened and renamed correspondingly.
3. The descriptive statistics worksheet will be created, which includes mean, median, mode, standard deviation, and skew.
4. The pass failed table shows percentage of students who pass or failed the test at each grade level.
5. The proficiency chart shows the percentage of students in each proficiency level for a given objective for each grade level.
6. The three tables are generated for both pre and post PERA test, and one combined worksheet will compare the average score for two cases and generate the t score.

The full set user stories for the cleaning tool is available at the appendix.

### **Recommendation**

The function of analyzing individual school with fewer than 10 students is disabled, but smaller schools might also wish to enable this function in the future. The analysts should reach an agreement with the school principals for this rule and confirm whether the report for grade level with fewer than 10 students is informational. The function of looping through the school list and providing reports for each of the registered school is enabled, but one caveat is that the number of worksheets created will be hard to manage. It is recommended to generate report individually for each school when necessary.

## **IV. Provide charting tool to visualize the test statistics**

### **Motivation**

Ministry of Education staff currently manually generates the graph for average score for all grade level. This charting tool can create graph for mean and median across all the grade levels. It can create a pie chart for each grade level to visualize the percentage of passed and failed students. It can create proficiency chart for each grade level to visualize the performance of each standard.

### **Outcomes**

The output was an charting tool written in Excel VBA. The outcomes of this new tool are as follows:

1. Generate bar chart for the descriptive statistics to visualize the average score and median score across all the grade levels.
2. Generate the pie chart for each grade level to visualize the percentage distribution between pass and failed test takers.
3. Generate the bar chart for each grade level to visualize the percentage distribution for the proficiency level of each objective.
4. Generate the bar chart to visualize the changing descriptive statistics between pre and post test

### **Recommendation**

The school-level charting might be lack of student records, it might be better for the analyst to choose to generate charts based on the number of student records. If the number is lower than 10, it is not representative to generalize the statistics.

### **About the Consultant**

Yaxuan (Rebecca) Li is a rising junior majoring in Information Systems with a minor in Business Optimization and Human Computer Interaction at Carnegie Mellon University. She took part in the Technology Consulting in the Global Community internship over the 2021 summer and will return in the fall to begin her junior year.

## Appendix

### Cleaning tool user story

As a <role>	I want to <goal>	So that I can <reason>
Scanning person	Scan the answer sheet	Send the all the results to the BCI
BCI specialist	Check the problematic student data	Send the correct version back to IT Manager
IT Manager	Identify the raw data with errors	Mark the problematic input and process the clean data
IT Manager	Create a new excel column to record all the problematic rows with missing information	Send to BCI to identify the input
IT Manager	Send the problematic input to BCI	More detailed personal information will be confirmed and recorded
IT Manager	Store information onto database	Have a backup data to look for if the information locally is lost or damaged

### Analysis tool user story

As a <role>	I want to <goal>	So that I can <reason>
IT Manager	See the students' performance for each standard	Know which the level of performance for specific direction
IT Manager	Calculate the average score nationally and school-wise	Know the overall performance and compare across different schools
IT Manager	See a chart comparing the average score with the previous test	Know if students improve on their performance
BCI specialist	Monitor the output of the reports	Identify which category is the problematic area
Subject (English) specialist	Math, English, Palauan studies, Science, Social studies, health, physical education See and evaluate the PERA results	Formally provide a plan to improve students' performance
School principal	See the students' performance for each grade level	Understand students' performance and come up with plans to improve in corresponding standards

School principal	See the median and standard deviation for each category	Know if the data is normally distributed or skewed
School principal	Compare students' performance with national average	Know which the level of performance the students underperformed or did well on