Vol.5 No.1 January - December 2020 ISSN: 2362 - 9096

JOURNAL
OF HIGHER EDUCATION RESEARCH DISCIPLINES

Vol.5 No.1 January - December 2020 ISSN: 2362 - 9096

CHED ACCREDITED JOURNAL

A Refereed Scientific Publication of
Northwestern Mindanao State College
of Science and Technology

JOURNAL OF HIGHER EDUCATION RESEARCH DISCIPLINES

JOURNAL OF HIGHER EDUCATION RESEARCH DISCIPLINES

VOLUME 5, ISSUE 1, JULY - DECEMBER 2020

The Journal of Higher Education Research Disciplines (J-HERD) is formerly the "NMSCST Research Journal," a refereed scientific publication of Northwestern Mindanao State College of Science and Technology, Tangub City, Philippines. This journal aims to publish research articles in sciences, social sciences, technology, tourism, agriculture, teacher education, and language and communication. This journal is a semi-annual publication of the institution, which seeks to unify these branches of inquiry by publishing quality, peer-reviewed research articles.

The Journal is open to all researchers from various disciplines of different universities and research agencies in the Philippines and outside the country. The publication is free of charge, but only quality papers are accepted.

Aims and Scope

The Journal of Higher Education Research Disciplines (J-HERD) is a peer-reviewed, multidisciplinary journal which aims to publish semi-annually research articles in the sciences, social sciences, technology, tourism, agriculture, teacher education, and language and communication. The contributors come from different universities and research agencies in the Philippines and outside the country. Submitted papers are products of an original work and have not been previously published.

Peer Review Process

The Peer Review (also known as refereeing) is the process of subjecting an author's scholarly work, research or ideas to the scrutiny of experts in the same field. It is a way of ensuring that the articles published are of high quality with minimal probability of errors.

The Journal of Higher Education Research Disciplines adopts the double-blind review process wherein the reviewer and the author do not know each other's identity. It is the obligation of the Editorial Team to assign the peer reviewers for a particular manuscript submitted for publication. These peer reviewers are not selected from among colleagues and those who are in close association with the author(s). Likewise, the editorial staff ensures that the peer reviewers must hold the distinction of having published in ISI or indexed journals, and have the expertise of the topic under review. Two external referees are invited for each research paper. However, only the paper that meets the editorial criteria is sent for formal review. Once a referee accepts the invitation, within a specified time frame (within 2 to 4 weeks), the referee provides feedback through the online journal system of NMSCST. Subsequently, the management evaluates the referee's decision and comments before notifying the author(s) about the result of refereeing.

A manuscript is accepted when it is endorsed for publication by the two (2) referees; the instructions of reviewers are substantially complied; ethical standard and protocols are followed for studies, including humans and animals; and manuscript passed the plagiarism detection with at least 85% for originality and at least 80% of grammar issues. Otherwise, it is rejected.

The editors make decisions based on the reviewer's advice, from among several possibilities;

Accept, with or without revision.

Invite the authors to revise their manuscript to specific concerns before a final decision is reached.

Reject, but indicate to the authors that they may resubmit the manuscript if revised thoroughly.

Reject outright, typically on grounds of technical and/or interpretational problems. Authors are advised to use licensed software for plagiarism detection and to perform spelling and grammar checks prior to paper submission.

Publication Frequency

J-HERD is published semi-annually, both print and online. Circulation is scheduled during the second and the last quarter of the year.

Open Access Policy

This journal provides open access to its content for wider dissemination of research findings and to support a worldwide exchange of knowledge.

Submission Preparation Checklist

As part of the submission process, authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

- The submission has not been previously published, nor is it before another journal for consideration (or an explanation has been provided in Comments to the Editor).
- The submission file is in Open Office, Microsoft Word, or RTF document file format.
- The text adheres to stylistic and bibliographic requirements outlined in the Author Guidelines.

Copyright Notice

The copyright of the article will be transferred to the Journal of Higher Education Research Disciplines and to the Northwestern Mindanao State College of Science and Technology. Once the paper is accepted for publication, the authors must accomplish and submit the copyright transfer document to J-HERD via email. Authors are responsible for ensuring that their papers do not infringe any existing copyright. The J-HERD and NMSCST shall not be held responsible for any infringement related to publication of unoriginal and fraudulent articles submitted by the authors.

Author Guidelines

Authors are advised to LOG IN and submit full papers through the online journal system (nmsc.edu.ph/ojs) of Northwestern Mindanao State College of Science and Technology. Manuscripts should be prepared in English, the length of which should not be more than 4000 words, and file size not exceeding 5MB. All submissions will undergo first-level evaluation and plagiarism-grammarly review prior to double-blind refereeing process.

Submission of a research paper is understood to mean that it is a product of original work, not published in other publications, and is not being considered for publication elsewhere. Journal shopping, publication of fraudulent data and other unethical practices will be grounds for withdrawal of an article published in the J-HERD. Violators will be required to refund the expenses incurred in the processing of the paper. The J-HERD and NMSCST shall not be held responsible for any infringement related to publication of unoriginal and fraudulent articles submitted by the authors.

In preparing the Manuscript, the following should be observed:

1. Organize the paper following these major headings: Title, Author(s) and Address(es), Abstract, Introduction, Conceptual Framework, Research Methodology, Results and Discussions, Conclusions, Acknowledgement and References. The References should substantially consist of articles published in current content-covered or peer-reviewed journals.

2. The entire manuscript double-spaced on a short white bond paper (8.5 x 11in) on one side only with 2.5cm margins all around using a Times new Roman font size of 12.

3. References, Acknowledgement, Table Titles, and Figure Legends should be typed-spaced. Number consecutively all pages, including title page, figures, and tables. Leave two spaces before and after the major headings and subheadings. Do not use footnotes, unless necessary for better comprehension.

4. Spell out acronyms or unfamiliar abbreviations when these are mentioned for the first time in the text.

5. Write the scientific names of species when it is first mentioned in the text and use the common name in succeeding references. Italicize scientific names.

6. Do not spell out numbers unless they are used to start a sentence.

7. Use the metric system only or the International System of Units. Use abbreviation of units beside numerals (e.g. 5m); otherwise spell out the units (e.g. Kilometers from here).

8. When preparing Tables and Figures, consider the journal's printed page of 5.75 in 8.5 in the reduction that will be necessary. Titles of Tables and Captions of Figures should be typed, double-spaced on a separate sheet. Figures should consist only of simple line drawings, computer-generated graphics or good quality black and white photographs. Label of Figures should be of such a size so that these are still legible even after reducing the size by as much as 50%.

9. Cite references in the text as the author (year). Cite three or more authors as (first author et al. year); references in press as (author, in press). If two or more references are cited, arrange them by year, (e.g, Padua, 2012; Lapinig, 2013, River, 2016).

10. Cover page should show the title of the paper, all authors' names, titles and affil-

iations, email addresses, and any acknowledgements.

Pagination: All pages, including tables, appendices and references, should be serially numbered. Major sections should be numbered in Hindu Arabic numerals. Sub-sections should not be numbered.

Abstract: An abstract of 100-250 words should be presented on a separate page immediately preceding the text. The abstract should concisely inform the reader of the manuscript's topic, methods, findings and conclusions.

Keywords: At least three keywords must be provided right after the abstract to assist in indexing the paper and identifying qualified reviewers.

Introduction: An introduction provides more details about the paper's purpose, literature cited, gaps in knowledge, and how the paper intends to address the gap.

Conclusions: Conclusions should briefly answer the objectives of the study. These are not repetitioning of the discussion, but are the judgements of the results obtained.

The article for publication must contain the following parts:

-Title
-Abstract
-Introduction
-Conceptual Framework
-Research Methodology
-Results and Discussion
-Conclusions
-References

However, for the scientific papers, the following parts may be applied:

-Title
-Abstract
-Introduction
-Methods and Materials
-Results and Discussion
-References

Criteria for publication to be published in the Journal for Higher Education Research Disciplines:

A paper is required to meet the following guidelines:

-Intellectual Value
-Essential Impacts and Originality
-Critical Quality

TABLE OF CONTENTS

PROBABILITY DISTRIBUTION OF THE LARGEST SEISMIC SIGNAL OF A RANDOM NUMBER OF SIGNALS

Roberto N. Padua[1], Dionisel Y. Regalado[2]
[1]*Liceo de Cagayan University*
[2]*Northwestern Mindanao State College of Science and Technology*
Volume 5, Issue No.1, January - December 2020

Abstract

The paper proposes a probability distribution for the largest seismic signal where the signals are assumed to obey a beta distribution and the number of signals is also assumed random. It is shown that the 7-year hourly seismic recordings for the Caraga region in the Philippines obey a beta distribution with parameters q and r estimated from the data. The probability distribution of the largest seismic signal exceeding a certain magnitude is constructed and is applied to the setting. Results reveal that approximately 236 of the largest seismic signals in the Caraga region will exceed magnitude 6 in any given year.

Keywords and Phrases:
Largest order statistics, random number signals, seismic modelling

1.0 Introduction

Seismic or earthquake signals are often analyzed as Poisson processes with prediction as a goal (Padua et al., 2017; Wei, 2013). For disaster preparedness purposes, however, the individual seismic signals are often not as important as the largest seismic signal:

$$y = \max_{1 \le i \le N} \{x_i\} \qquad (1)$$

that could hit a given region. If the density and cumulative distribution functions of x were f(x) and F(x) respectively, then elementary methods show that the cumulative distribution and density of (1) are respectively:

$$G(y) = [F(y)]^N$$
$$g(y) = N\,[F(y)]^{N-1} \cdot f(y) \qquad (2)$$

Given N, the number of earthquakes that could strike a given region over the time interval [0,τ],Equation (2) can be used to estimate the probability P(Y>y). However, N may also be an integer – valued random variable N with probability mass function, p(N), hence:

$$g(y) = \sum_{N=1}^{\infty} N\,[F(y)]^{N-1} f(y) \cdot p(N) \qquad (3)$$

(Hao and Godbole, 2014).

Surprisingly, (3) has a nice closed – form solution for many pairs of random variable X and N (Hao and Godbole, 2014). In this paper, we shall examine those pairs that arise in the analysis of seismic signals. The data available from the Caraga region of the Philippines from 2011 to 2017 are used for model validation.

2.0 Probability Distribution of Seismic Signals

2.1 As Bounded Random Variables

Let $x_1^*, x_2^*, \ldots, x_N^*$ be seismic signals measured on a Richter scale. The largest earthquake recorded by the United States Geological Survey (USGS) was magnitude 9.2 in Valdivia, Chile on May 22, 1960 (Kanamon and Anderson, 1975). There is sufficient reason to believe that $0 \leq x_i^* \leq 10$. We shall consider the random variables:

$$x_i = \frac{x_i^*}{10}, \quad 0 \leq x_i \leq 1.0 \qquad (4)$$

The beta density with parameters q and r is a reasonable model for the distribution of (4):

$$f(x) = \frac{1}{B(q,r)} (x)^{q-1}(1-x)^{r-1} \qquad (5)$$

where:

$$B(q,r) = \int_0^1 x^{q-1}(1-x)^{r-1}\, dx \qquad (6)$$

Let N be an integer – valued random variable with distribution function:

$$P(N = n) = (1-\rho)^{n-1}\rho, \quad n = 1, 2, 3, \ldots \qquad (7)$$

or the geometric "waiting time distribution". We shall be interested in the distribution of

$$y = \max_{1 \leq i \leq N} \{x_i\} \qquad (8)$$

Using (3), we obtain:

$$g(y) = \sum_{N=1}^{\infty} N\,[F(y)]^{N-1} \cdot f(y) \cdot (1-\rho)^{N-1}\rho \qquad (9)$$

where $f(y)$ is given by (5) and $F(y) = \int_0^y f(y)dy$. Thus,

$$g(y) = \frac{\rho}{1-\rho} \sum_{N=1}^{\infty} \frac{d}{dy}[(1-\rho)\,F(y)]^N$$

$$= \frac{\rho}{1-\rho} \frac{d}{dy}[\sum_{N=1}^{\infty}(1-\rho)\,F(y)]^N$$

$$= \frac{\rho}{1-\rho} \frac{d}{dy}\left[\frac{(1-\rho)F(y)}{1-(1-\rho)\,F(y)}\right]$$

$$= \rho \frac{d}{dy}\left[\frac{F(y)}{1-(1-\rho)\,F(y)}\right]$$

$$g(y) = \frac{\rho\, f(y)}{[1-(1-\rho)\,F(y)]^2} \qquad (10)$$

We have proved:

Theorem 1. Let $x^1, x^2, \ldots, x^N$ be bounded seismic signals with distribution:

$$f(x) = \frac{1}{B(q,r)} x^{q-1}(1-x)^{r-1}, \qquad 0 < x \leq 1 \qquad (11)$$

and let N be an integer – valued geometric random variable with parameter ρ:

$$P(N = n) = (1-\rho)^{n-1}\,\rho, \quad n = 1, 2, \ldots \qquad (12)$$

Then, $y = \max_{1 \leq i \leq N} \{x_i\}$ is distributed as:

$$g(y) = \frac{\rho\, f(y)}{[1-(1-\rho)\,F(y)]^2} \qquad (13)$$

where $f(y)$ and $F(y)$ are the pdf and cdf of x respectively.

From (13), it is easy to derive the cumulative distribution function $G(y)$ which is given by:

$$G(y) = \frac{\rho\, F(y)}{[1-(1-\rho)\,F(y)]} \qquad (14)$$

3.0 Parameter Estimation

The parameters q and r of the beta distribution needs to be estimated from data. Let $x \overset{d}{\sim} Be(q,r)$, then it is easy to show that:

$$E(x) = \frac{q}{q+r}$$

$$Var(x) = \frac{qr}{(q+r)^2(q+r+1)} \quad (15)$$

The method of moments estimators are then given by:

$$\hat{q} = \bar{x}\left(\frac{\bar{x}(1-\bar{x})}{s^2} - 1\right) \quad , \quad s^2 < \bar{x}(1-\bar{x})$$

$$\hat{r} = (1-\bar{x})\left(\frac{\bar{x}(1-\bar{x})}{s^2} - 1\right) \quad , \quad s^2 < \bar{x}(1-\bar{x})$$

where: (16)

$$s^2 = \frac{1}{N-1}\sum_{i=1}^{N}(x_i - \bar{x})^2$$

$$\bar{x} = \frac{1}{N}\sum_{i=1}^{N} x_i$$

Since the recorded seismic signals are observed on an hourly basis, there will be a total of 8, 760 ideal recordings per year. One naïve estimator of ρ in the geometric distribution is given by:

$$\hat{\rho} = \frac{\#\ of\ recorded\ seismic\ signals\ in\ one\ year}{8760} \quad (17)$$

4.0 Largest Earthquakes In the Caraga Region, Philippines and Construction of an Empirical Hazard Function

Data from the website of the PHILVOLCS were obtained from 2011 to 2017 consisting of hourly recordings of seismic signals in the Caraga region. Figure 1 shows the histograms of the data for 2011 to 2017:

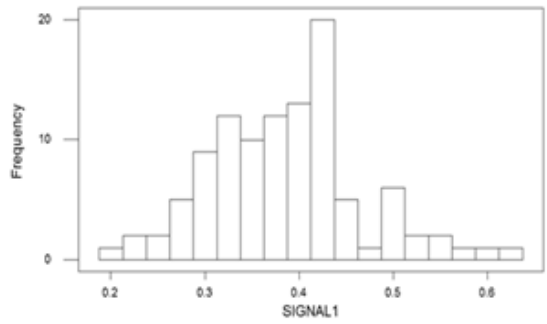

Figure 1:
Histogram of year 1 earthquake signals

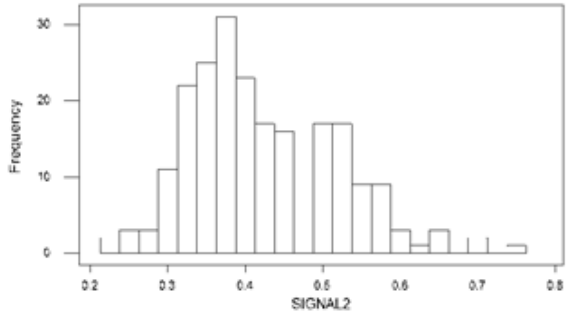

Figure 2:
Histogram of year 2 earthquake signals

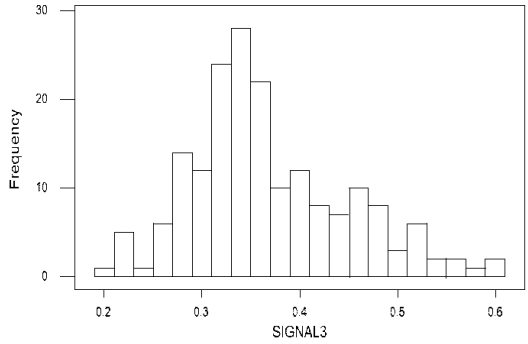

Figure 3:
Histogram of year 3 earthquake signals

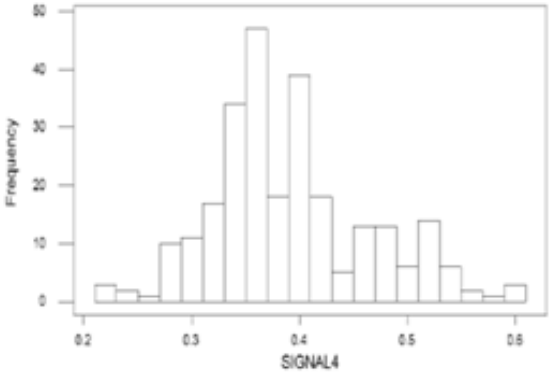

Figure 4:
Histogram of year 4 earthquake signals

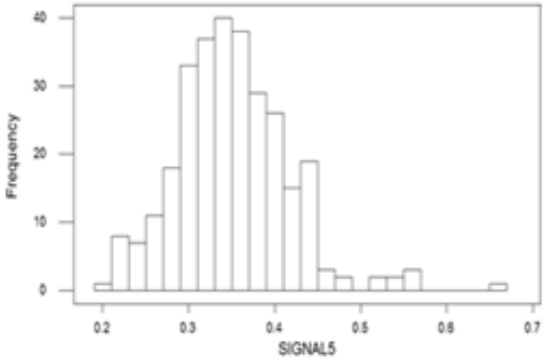

Figure 5:
Histogram of year 5 earthquake signals

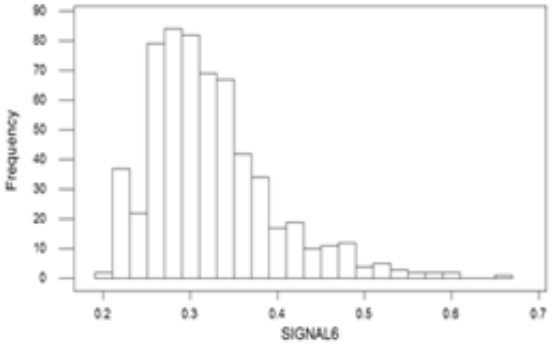

Figure 6:
Histogram of year 6 earthquake signals

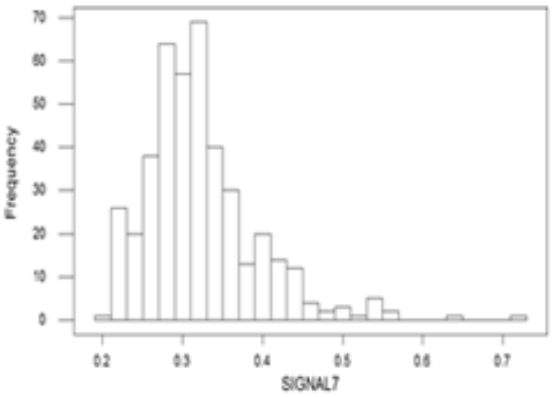

Figure 7:
Histogram of year 7 earthquake signals

The histograms all show a general tendency to be positively skewed (q < r). The time series data of all seismic signals over the six-year period consisted of 2,105 observations. The general histogram similarly displayed the same positive-skewness.

Table 1 shows the method of moment's initial estimates of the parameters of the beta distributions:

Table 1: *Initial Method of Moments Estimator of the Beta Parameters*

Year	Q	r	N	ρ
1	14.2513	22.876	105	.012
2	11.3435	15.3854	228	.030
3	13.2097	22.6375	183	.020
4	16.7968	26.0828	263	.030
5	17.6506	32.6318	295	.034
6	13.0129	27.3084	606	.069
7	13.534	28.5507	423	.048
COMBINE	**11.3018**	**20.71**	**2105**	**.0343**

Table 2 shows the probability that the largest seismic signal exceeds x:

$$H(x) = P(Y \geq x) = 1 - P(Y \leq x) = 1 - G(x)$$

Tabular values show that the probability that the largest seismic signal of magnitude greater than 4 on the Richter scale will hit the region in the future is about 85.29%. Next given that an earthquake of magnitude greater than 4 has struck the region, the probability that it will exceed magnitude 5 is 35.14% (0.2997139/0.8528741) or more than a third of the time. Destructive earthquakes of magnitude greater than 6 will hit the region given that an earthquake of magnitude greater than 5 has struck the region occur with probability 2.720% (0.0081527/0.2997139) .

In more practical terms, of the possible 8,760 hours of seismic recordings approximately 236 of the largest magnitudes may be at least as large as magnitude 6 in any given year.

Figure 8 shows the plot of the probability function.

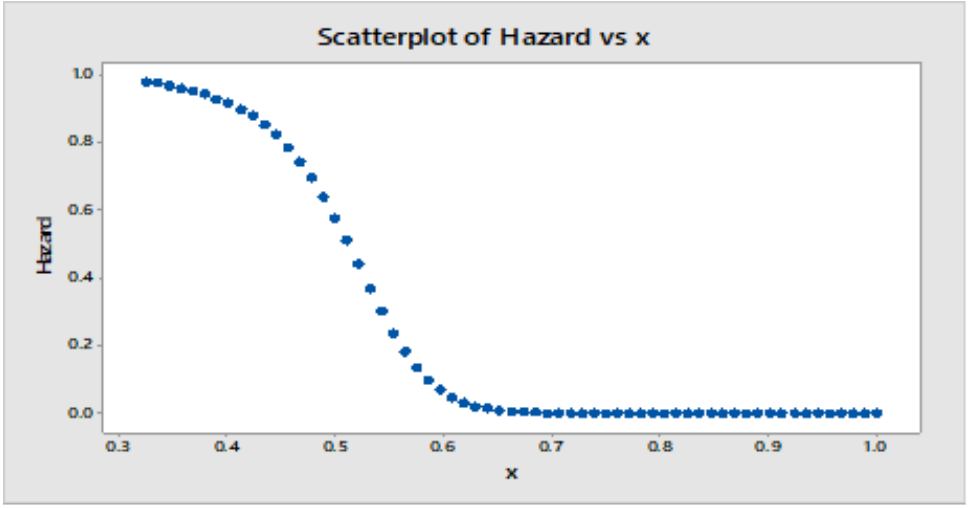

Figure 8: *Hazard Function*

Table 2: *Probability that Largest Seismic Signal Exceeds X*

X	Normed x	H(x)	x	Normed x	H(x)
3.0	0.326087	0.9787071	6.2	0.673913	0.002935
3.1	0.336957	0.9738798	6.3	0.684783	0.001694
3.2	0.347826	0.9680977	6.4	0.695652	0.000952
3.3	0.358696	0.9611686	6.5	0.706522	0.00052
3.4	0.369565	0.9528567	6.6	0.717391	0.000275
3.5	0.380435	0.9428732	6.7	0.728261	0.000141
3.6	0.391304	0.9308667	6.8	0.73913	6.98E-05
3.7	0.402174	0.9164126	6.9	0.75	3.33E-05
3.8	0.413043	0.8990045	7	0.76087	1.52E-05
3.9	0.423913	0.8780497	7.1	0.771739	6.65E-06
4	0.434783	0.8528741	7.2	0.782609	2.77E-06
4.1	0.445652	0.8227437	7.3	0.793478	1.09E-06
4.2	0.456522	0.786913	7.4	0.804348	4.07E-07
4.3	0.467391	0.7447104	7.5	0.815217	1.42E-07
4.4	0.478261	0.6956709	7.6	0.826087	4.59E-08
4.5	0.48913	0.6397138	7.7	0.836957	1.37E-08
4.6	0.5	0.5773416	7.8	0.847826	3.72E-09
4.7	0.51087	0.5098062	7.9	0.858696	9.07E-10
4.8	0.521739	0.4391612	8	0.869565	1.95E-10
4.9	0.532609	0.3681226	8.1	0.880435	3.64E-11
5	0.543478	0.2997139	8.2	0.891304	5.70E-12
5.1	0.554348	0.2367718	8.3	0.902174	7.21E-13
5.2	0.565217	0.1814685	8.4	0.913043	7.04E-14
5.3	0.576087	0.1350145	8.5	0.923913	6.66E-15
5.4	0.586957	0.0976214	8.6	0.934783	0
5.5	0.597826	0.0686859	8.7	0.945652	0
5.6	0.608696	0.0470878	8.8	0.956522	0
5.7	0.619565	0.0314871	8.9	0.967391	0
5.8	0.630435	0.0205523	9	0.978261	0
5.9	0.641304	0.0130994	9.1	0.98913	0
6	0.652174	0.0081527	9.2	1	0
6.1	0.663043	0.0049527			

References

Hao, J. and Godbole, A. (2014). "Distribution of the Maximum and Minimum of a Random Number of Bounded Random Variables" (Department of Mathematics and Statistics, East Tennessee State University, arXiv:1302v1,math. ST)

N. Johnson, S. Kotz, and N. Balakrishnan. Continuous Univariate Distributions, Vol. 2. Wiley, New York, 1995.

Padua, R.N., Regalado D. Y. and Libao, M. F (2017). "Stochastic Formulation Of Logistic Dynamics And Parameter Estimation By The Largest Order Statistics" (Recoletos Multidisciplinary Journal, Vol 8, pp. 35-41.)

S. Kotz and J. van Dorp. Beyond Beta: Other Continuous Families of Distributions with Bounded Support and Applications. World Scientific Publishing Co., Singapore, 2004.

CHARACTERIZATION OF MINING BEHAVIOUR OF SELECTED METALS IN THE PHILIPPINES THROUGH A BASS DIFFUSION MODEL

Jhudiel M. Lobitaña
Northwestern Mindanao State College of Science and Technology
Volume 5, Issue No.1, January - December 2020

Abstract

This study looks at the adoption of Filipinos on the mining operation of the four primary metallic commodities in the country. The statistical model employed in the analysis of adoption is a Bass Diffusion Model. The study revealed that Filipinos are adopting the metallic mining operations for the four different types of metallic commodity, with nickel mining as the only operation which reaches its saturation level and has the fastest rate of saturation. However, the remaining quantity of mineral deposits was found to be significant in improving the economy of the Philippine. Thus, responsible mining must be allowed to diffuse in the identified high mineral potential sites in the country.

Keywords:

Adoption, Bass Diffusion Model, Diffuse, Metallic Commodity, Mineral Reserves, Pearson Product Moment Coefficient of Correlation, Saturation, Innovative, Imitative, Imitator

1.0 Introduction

One of the country's wealth is its mineral deposits. This asset can significantly contribute to the economic development of a country if this is utilized responsibly. In the Philippines, approximately 9 million hectares of land were determined by the Mines and Geosciences Bureau as having a high mineral potential for nickel, gold, copper, and chromite. These mineral deposits are usually located in the province of Surigao del Norte, Benguet, Eastern Samar, and Cebu respectively. If only we utilized this asset by following the right regulation and observing the proper implementation of the law that emphasizes environmental protection, the mining for this metallic commodity could be a way for Filipinos out of poverty.

Consequently, the assessment of the adoption of Filipinos is conducted using the Bass Diffusion Model. According to Frank Bass (1969), Bass Diffusion is a growth model that describes the process of the adoption of prospective users to the new commodity. Bass (1969) further points out that the behavioral rationale for the Bass Model is provided in the matter of inventive and imitative behavior. In this study, the model is used to describe the growth or adoption of mining operations in the potential mining sites in the country with mining operations as the new product for adoption and the identified high mineral potential sites as the market potential.

Moreover, according to Bracamonte (2015), the operation of quarrying in the country has been in practice since the pre-colonial period. This means that there is already an initial mining activity that promotes the

diffusion of the mining operation. According to the Mineral Mining Statistics report released last August 5, 2016, the mining in the country has increased since 1997 from the initial number of 17 operating metallic mines to 48 in 2018. This signifies that there is an imitator that adopts the mining operations in the identified high mineral potential sites in the country. Thus, with the presence of the initial number of mining operations and the increasing number of mining imitator, the mining operations in the Philippines follow a bass diffusion model. By using this model, the adoption of mining operations for the four different metallic commodities in the Philippines is observed and characterized

2.0 Conceptual Framework

The study claims that Filipinos are adopting the mining operations for the four different metallic commodities in the country. The above-mentioned notion can be more understood through the diagram presented below.

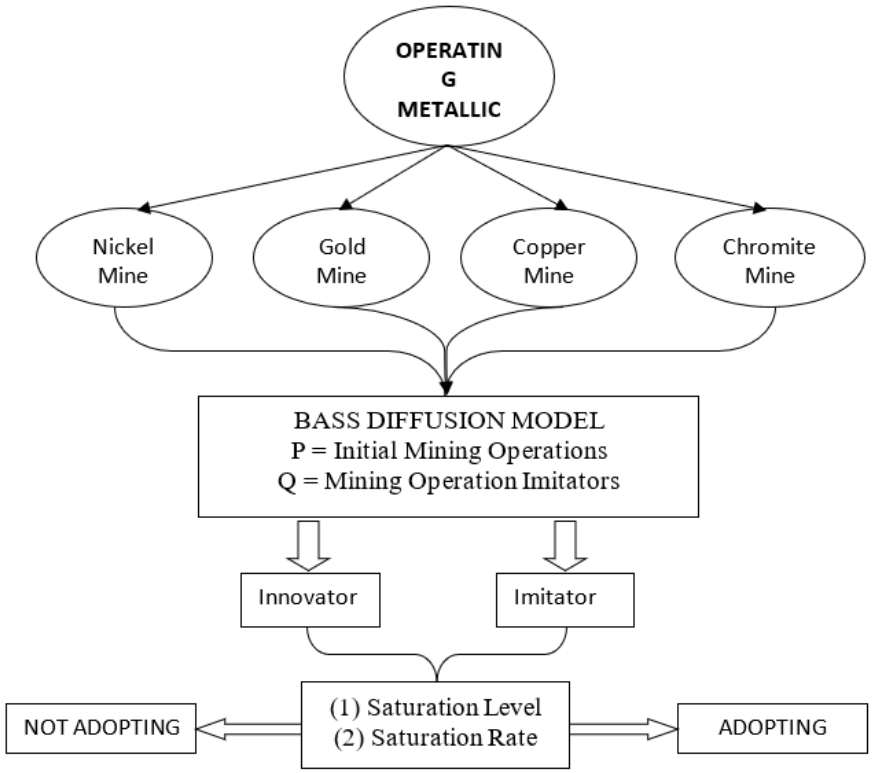

Figure 1: *Conceptual Framework of the Study*

3.0 Research Methods and Design

The present study utilizes secondary data. These data are obtained from the report of the Mining Industry Statistics of the Mines and Geosciences Bureau of the Republic of the Philippines from 1997-2018. The study employs linear regression to determine the p and q values. Saturation F(Ts) is calculated using a Bass Diffusion Model. Then, saturation is plotted against time using a scatterplot to determine the adoption rate of mining activity specifically for nickel, gold, copper, and chromite in the country. The study is limited only to mining operations that are listed in the mines and geosciences bureau. These are medium to large scale mines. Also, possible effects of mining diffusion such as employment opportunity and taxes are correlated with the number of mining operations using Pearson Product Moment Coefficient of Correlation to discover if there is a connection between these variables.

Bass Diffusion Model

$$(1) \quad \frac{f(t)}{1-F(t)} = p + qF(t)$$

Successive Generation

$$(2) \quad F(T_s) = \frac{1-e^{-(p+q)t}}{1+\frac{q}{p}e^{-(p+q)t}}$$

where:

f(t) is the proportion of new operational mining site at time t
F(t) is the cumulative proportion of operational mining site at time t
p is the coefficient of innovation
q is the coefficient of imitation
F(Ts) is the saturation level
Ts is the saturation time

Pearson Product Moment Coefficient of Correlation

$$(3) \quad r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{n(\Sigma x^2)-(\Sigma x)^2}\cdot\sqrt{n(\Sigma y^2)-(\Sigma y)^2}}$$

where:

x is the number of mining operations
y is the number of employment/taxes
r is the Pearson correlation coefficient

4.0 Results and Discussion

According to Frank Bass (1967), diffusion is the process of new product adoption. In this present study, diffusion is delineated as a phenomenon where metal mining operation continues to diffuse in the identified high mineral potential sites in the country. Figure 2 shows a scatterplot of diffusion of nickel, gold, copper, and chromite mining operations.

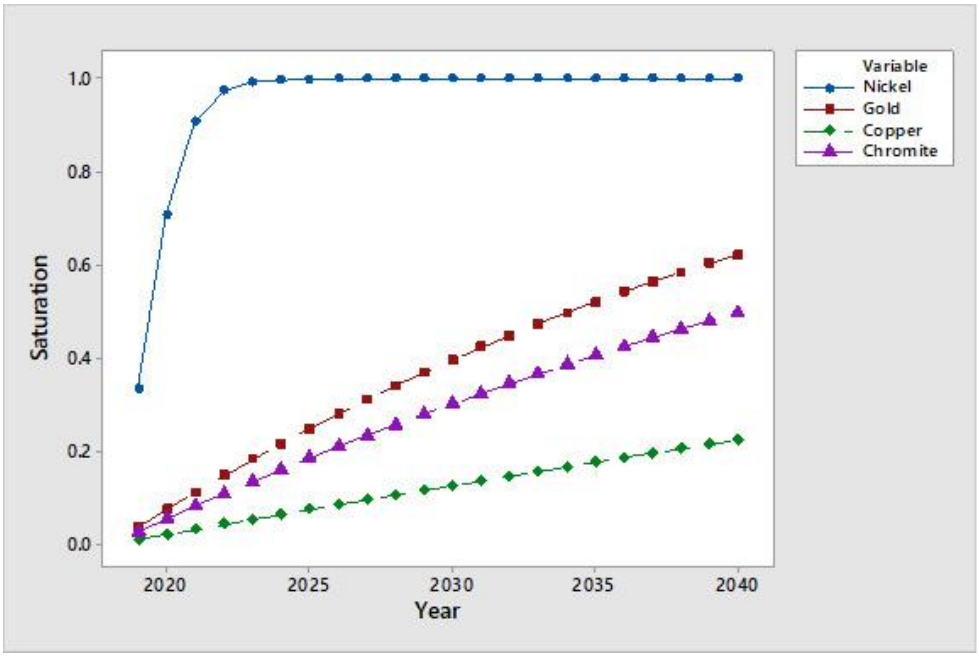

Figure 2: *Saturation of Metallic Mine Operations per Year*

The result shows that nickel mining is the only metallic operation that reaches its saturation level. It also has the fastest rate of diffusion. This means that approximately all identified potential sites for nickel will be explored by 2023. As a result, eventual depletion of this metallic element in the permitted mining sites will occur. However, the diffusion of mining operations for the other metallic commodities continues to diffuse in the Philippines, with gold mining as the second in diffusion followed by chromite and copper mining respectively. This implies that the production of the three metallic commodities will continue until all the permitted mining sites are saturated and exhausted.

Moreover, one of the possible factors that affect the saturation of nickel potential sites is the increase in the demand for this type of metal in the international market for the fabrication of many factory-made and consumer products. Currently, the country is one of the biggest suppliers of nickel in the world. As of 2019, the value of nickel equals 11,580 US$/Mt base on London Metal Exchange. This attracts mining investors to go for nickel mining instead of the other metals. However, the rarity of gold and its high value in the international market makes gold mining second in diffusion. Also, chromite mining is the third in diffusion because of its improving functionality and worth in global market. According to the United States Geological Survey, the current value of chromium is 9,000 US$/Mt. Lastly, copper mining is the slowest in diffusion because it has the lowest in value which equals 5,770 US$/Mt base on the London Metal Exchange. This makes copper mining the least priority to mine among the other three metals.

Consequently, figure 3 shows the scatterplot of correlation between mining operations and employment in order to determine the effect of mining adoption in the employment of Filipinos.

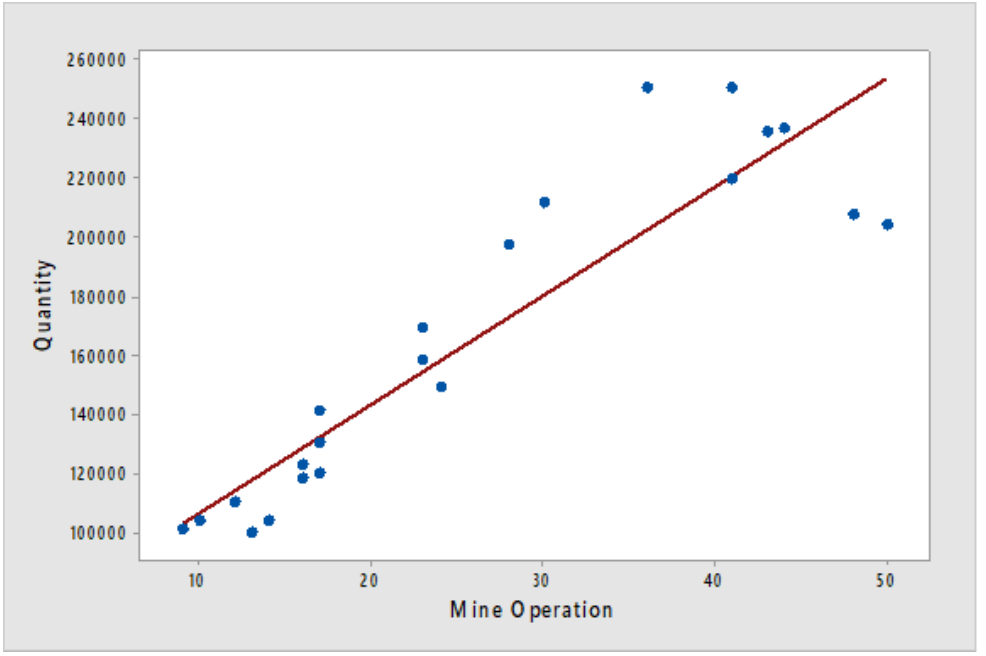

Figure 3: *Correlation of Employment and Total Mine Operations*

The Pearson correlation value for the data plotted in Figure 3 is 0.91. This suggests that there is a strong relationship between employment and mining operations, which means that the increase of the number of mining operations results in the increase of job opportunities or employment for the Filipinos as presented in the graph. Not only that, according to the Mines and Geosciences Bureau, every job in the mining industry also generates at least four indirect jobs. As a result, more Filipinos can become productive and earn at the same time because of the mining industry.

Furthermore, figure 4 presents the scatterplot of taxes received by the government both local and national including its agencies versus mining operations in order to determine the effect of mining in the economy of the country.

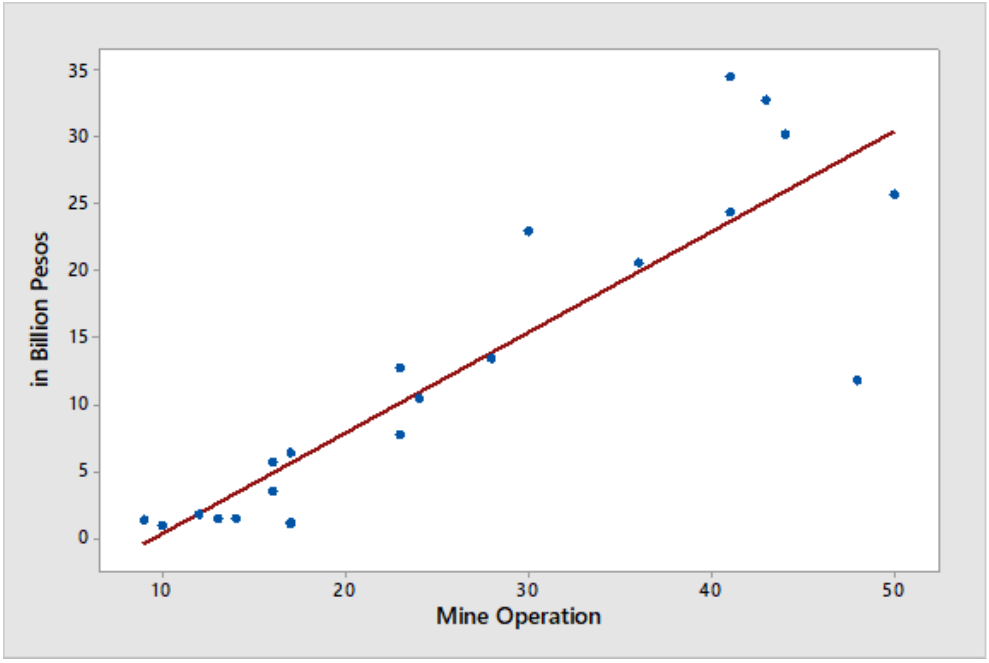

Figure 4: *Correlation of Royalties (taxes and fees) versus Total Mine Operations*

The Pearson correlation value for the data plotted in Figure 4 is 0.88. This suggests that there is a strong relationship correlation between taxes (fees and royalties) and mining operations, which implies that the increase in the number of mining operations increases the amount of taxes (fees and royalties) received by the government as shown in Figure 4. According to the Mines and Geosciences Bureau, the mining industry alone contributed the total amount of ₱25.7 billion in 2017 to the Philippine economy. Consequently, it increases the financial capability of the country. Aside from this, the current estimated amount of Philippine mineral deposits as of 2018 equals to $1.4 trillion bases on Philippine Extractive Industries Transparency Initiative (EITI Philippines). This is equivalent to ₱72.94 trillion. If utilized responsibly, the Philippines will be able to pay its debts as of 2019 of January in the amount of ₱7.5 trillion as of the Philippine Bureau of the Treasury report presents.

5.0 Conclusion

The study concludes that Filipinos adopt the mining operations for the four different metallic commodities in the country. Only nickel mining reaches its saturation level and has the fastest rate of diffusion. However, the mining operations for the other three metals continue to diffuse in the identified high mineral potential sites. Also, as Filipinos adopt the mining operations, more job opportunity is generated and income of the government from mining also increases as diffusion of mining operations continue. Thus, responsible mining must be allowed to improve the economy of the Philippines.

References

Mining Facts and Figures. (March 2019). Mines and Geosciences Bureau of the Department of Environment and Natural Resources. Retrieved at http://mgb.gov.ph/. Accessed on June 55, 2019.

Philippines Mining and Mineral Industry. (January 2019). Triple I Consulting. Retrieved at https://www.tripleiconsulting.com/industry-reports/mining-minerals/. Accessed on June 5, 2019.

Metallic Ores and Industrial Minerals of the Philippines. Mines and Geosciences Bureau of the Department of Environment and Natural Resources. Retrieved at http://mgb.gov.ph/. Accessed on June 5, 2019.

The Bass Model. (2010). Bass's Basement Research Institute. Retrieved at http://www.bassbasement.org/BassModel/Default.aspx. Accessed on June 5, 2019.

Mineral Industry Statistics. (May 2019). Mines and Geosciences Bureau of the Department of Environment and Natural Resources. Retrieved at http://mgb.gov.ph/. Accessed on June 5, 2019

Metal Prices. (June 7, 2019). Mines and Geosciences Bureau of the Department of Environment and Natural Resources. Retrieved at http://mgb.gov.ph/. Accessed on June 10, 2019

Directory of Operating Metallic Mines in the Philippines. (February 2019). Mines and Geosciences Bureau of the Department of Environment and Natural Resources. Retrieved at http://mgb.gov.ph/. Accessed on June 5, 2019

An Overview of Minerals Potential and Opportunity in the Philippines. (2005) Mines and Geosciences Bureau of the Department of Environment and Natural Resources. Retrieved at http://mgb.gov.ph/. Accessed on June 5,2019

Bracamonte, N.L. (2015) Developing a Shared Agenda for Mining Development in the Philippines. Retrieved at https://www.im4dc.org/wp-content/uploads/2015/09/Bracamonte-combined.pdf. Accessed on July 9, 2019.

Hilotin, J. (March 11, 2019) Gold in the Philippines: How much is it really worth? Retrieved at https://gulfnews.com/world/asia/philippines/gold-in-the-philippines-how-much-is-it-really-worth-1.1552204923140 Accessed on June 10, 2019

Natural Resources of the Philippines (July 3, 2019) EITI Philippines. Retrieved at https://eiti.org/philippines#production Accessed on July 9, 2019.

Bass, F. (1967). A New Product Growth Model for Consumer Durables. Retrieved from http://www.bassbasement.org

DOMINANT CULTURE PREVAILING IN TWO AGRICULTURAL STATE UNIVERSITIES IN CENTRAL LUZON

Sidrid Ann V. Jao and Ambrosio M. dela Cruz
Centro Escolar University, San Miguel, Manila
Volume 5, Issue No.1, January - December 2020

Abstract

This qualitative and quantitative paper aimed to comparatively assess the present and preferred organizational cultural profile of Pampanga State Agricultural University (PSAU) and Tarlac Agricultural University (TAU) in Central Luzon, Philippines using Organizational Culture Assessment Instrument (OCAI) as a survey tool based on Competing Values Framework (CVF Mode) of Quinn and Rorbaugh. OCAI allows a diagnosis of dominant orientation of an organization on four culture types namely: clan, adhocracy, market, and hierarchy using the six (6) dimensions of the organizational culture which are dominant characteristics, organizational leadership, management of employees, organizational glue, strategic emphases, and criteria of success. PSAU has a present and preferred dominant Clan Culture. However, the study shows that TAU's organizational culture at present is Hierarchy though the stakeholders preferred a Clan Culture in the coming years. Overall, present and preferred culture for the agricultural state universities in Central Luzon is Hierarchy . The dimensions of organizational culture are all with very significant relationship and substantial correlation to tangible improvements: thereby, rejecting the null hypothesis. The study also revealed that management of employees and organizational glue influenced most of the tangible improvements while organizational leadership and strategic emphases impact none of the dependent variables.

Keywords:

Agricultural State University, Organizational Culture, Organizational Culture Assessment Instrument

Introduction

The popularity of organizational culture as a tool to analyze schools develops from the literature on corporate cultures (Hoy, 1990). Burton Clarck pioneered work on distinctive colleges as cultures and recently, studies on organizational culture at a higher education institution has increasingly became popular (Coman & Bonciu, 2016; Vasyakin, et al., 2016; Kalaw, 2014). One such study, is a case study of the organizational culture by Vasyakin, et al.(2016) in Plekhanov Russian University of Economics (PRUE) that used survey methodology using the OCAI of Quinn and Cameron (2006) adapted for higher education institutions.

The nature of the school as a workplace has been of concern to researchers of educational institutions for quite some time, however it is only recently that other academic reformers and scholars have become enthralled with the topic as well (Hoy,1990). Relatively little is known about organizational culture in the Philippine context specifically in tertiary education or Higher

Education Institutions (HEI). State universities and colleges (SUCs), private sectarian and non-sectarian tertiary institutions comprise the higher education institution that are managed indirectly by the Commission on Higher Education (CHED) by virtue of RA 7722. Agriculture oriented state colleges and universities is one of the original thrusts of state higher education. The government in the Philippines has established many agricultural schools to meet the needs of the sector. Through the years, they have aimed to become state universities and colleges and were converted into such. Organizational culture differs from one institution to the other. It is not only in corporation that such exists but also in government funded agricultural state universities. Thus, this paper aims to identify the culture of this universities and be a model in the country in assessing other educational institutions.

Conceptual Framework

The Organizational Culture Assessment Instrument (OCAI) have a vast range of usage as a tool to comprehensively assess organizational culture. Due to the uniqueness of the researcher's study and to be applicable to the chosen respondents the conceptual framework of this study is a modification of the OCAI structured by Cameron and Quinn (2006) to explore the organizational culture of the two (2) agricultural state universities in Central Luzon.

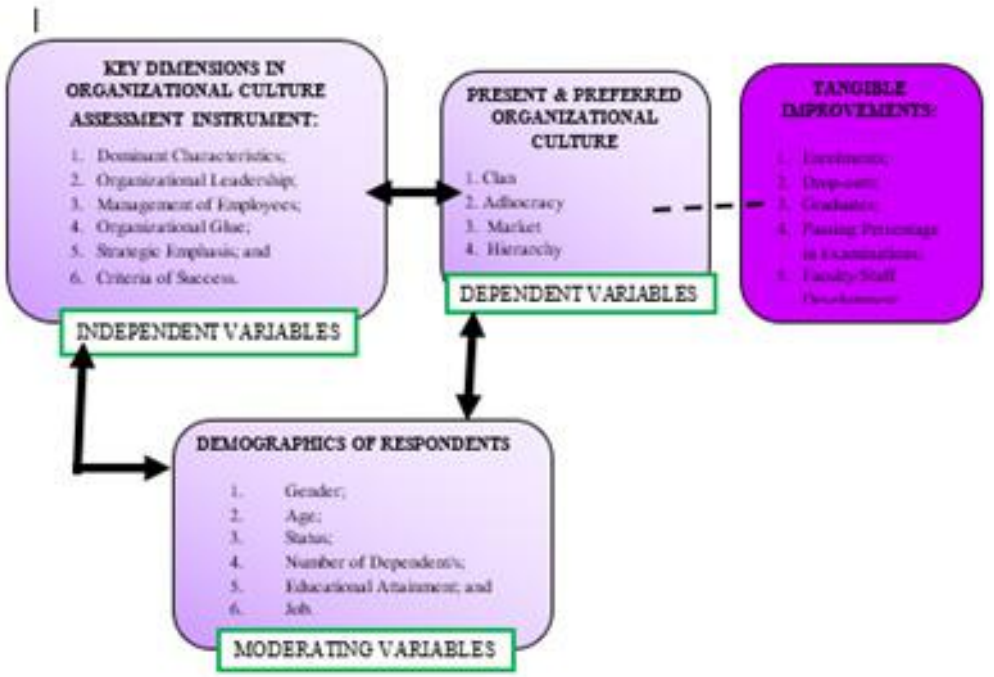

Figure 1: *Conceptual Framework of Organizational Culture of Two (2) Agricultural State Universities in Central Luzon*

Figure 1 illustrates the track of research of this study. A number of variables were presented to the external and internal stakeholders to gauge the existing and ideal culture of the institutions from the perspective of the respondents. It assists in diagnosing organization's first cultural strength, second cultural type, and third cultural congruence by answering the six (6) OCAI questions or the six (6) key dimensions of the organizational culture which are:(1) The dominant characteristics of the organization, or what the overall organization is like;(2) The leadership style and approach that permeate the organization; (3) The management of employees or the style that characterizes how employees are treated and what the working environment is like; (4) The organizational glue or the binding mechanism that hold the organization together; (5)The strategic emphases that define what areas of emphasis drive the organizations strategy; and (6) The criteria of success that determine how victory is defined and what gets rewarded and celebrated. The OCAI as an organizational culture assessment instrument allows a diagnosis of the dominant orientation of an organization or institution centered on these four types of culture which are clan, adhocracy, market and hierarchy. On the other hand, the moderating variables of the study are the respondents' profile: sex; age; marital status; dependents; educational attainment; and job title or rank.

After identifying the organizational culture of each university, the researcher determined if the dimensions of organizational culture influenced the tangible improvements of the university. These tangible improvements are the study's dependent variables which includes enrolment, dropouts, graduates, passing percentage in examinations, and faculty /staff development.

Methods and Design

The study was limited and conducted in Pampanga State Agricultural University (PSAU) in Magalang, Pampanga and Tarlac Agricultural University (TAU) in Camiling, Tarlac. Both are state funded institutions in the region of Central Luzon in the Philippines.

To compute the sample size of the respondents, the researcher applied Tabachnick and Fidell model (2007). As a result, in this study the minimum desirable number of respondents is 110. Nevertheless, the number of respondents reached 219 composed of the 34 internal stakeholders and 38 external stakeholders in PSAU while TAU had 57 internal stakeholders and 90 external stakeholders.

The questionnaire was the mode of gathering data to obtain relevant information to address the objectives of the study. To come up with a tool applicable to the respondents' needs, the proponent formulated a modified version of the combination of the Competing Values Framework (CVF) using the Organizational Culture Assessment Instrument (OCAI) structured by Cameron and Quinn (2006). The internal stakeholders answered the modified English version of the questionnaire while the external stakeholders responded to its Filipino translated version certified correct by the Komisyon sa Wikang Filipino (KWF). Both versions were composed of three (3) parts. The Profile of the Respondents is the first part of the questionnaire. Part II is meant to determine the organizational culture profile of the agricultural state university using the dimensions of organizational culture with four (4) items each. In Part II, the respondents used the Likert's four (4) point rating scale to know the relationship amongst the six (6) di-

mensions with respect to tangible improvements. The "NOW" and "PREFERRED" columns determined the present and the ideal (after five years) organizational culture profile of the agricultural state university using Ipsative rating scale. In Ipsative rating the respondents were given one hundred (100) points score among four (4) alternatives for each dimension. They were asked to rate each dimension that corresponds to their institution; to choose the option that is most true to the respondents and pick another that they consider the least true. Each of the dimension was divided into four parts (A, B, C, and D). "A", corresponds to Clan Culture, "B" for Adhocracy Culture, Market Culture is represented by "C", and Hierarchy Culture is symbolized by "D" . Part III pertains to tangible improvements. with respect to enrolment, drop-outs, graduates, passing percentage in examinations and faculty/staff development.

Results and Discussion

The following are presentation of results to address the objectives of the study imperative to accept or reject the research's hypothesis.

The Present and Preferred Organizational Culture Profile of Participating Agricultural State Universities

It can be determined by completing the Ipsative part of the questionnaire in Part II. Table 1 shows that the overall dominant present and preferred organizational culture of Pampanga Agricultural State University (PSAU) is Clan Culture. From Hierarchy Culture, the repondents from the Tarlac Agricultural University preferred a more clannish culture. While Hierarchy Culture is the dominant present and preferred culture of the agricultural state universities in Central Luzon. There are 4 out of 6 cultural congruence wherein the preferred culture is different from the present culture. Dominant characteristics together with organizational leadership, management of employees, and criteria of success are the same for present and preferred culture

DIMENSIONS IN ORGANIZATIONAL CULTURE	PSAU		TAU		Agricultural State Universities in Central Luzon	
	PRESENT	PREFERRED	PRESENT	PREFERRED	PRESENT	PREFERRED
1. Dominant Characteristics	D. Hierarchy	D. Hierarchy	D. Hierarchy	D. Hierarchy	D. Hierarchy	D. Hierarchy
2. Organizational Leadership	A. Clan	A. Clan	D. Hierarchy	B. Adhocracy	A. Clan	A. Clan
3. Management of Employees	A. Clan	A. Clan	D. Hierarchy	D. Hierarchy	A. Clan	A. Clan
4. Organizational Glue	D. Hierarchy	D. Hierarchy	C. Market	C. Market	C. Market	A. Clan
5. Strategic Emphases	C. Market	A. Clan	D. Hierarchy	D. Hierarchy	B. Market	A. Clan
6. Criteria of Success	D. Hierarchy	A. Clan	C. Market	D. Hierarchy	D. Hierarchy	D. Hierarchy
OVERALL	**A. Clan**	**A. Clan**	**D. Hierarchy**	**A. Clan**	**D. Hierarchy**	**D. Hierarchy**

Table 1: *Organizational Culture of the Agricultural State Universities*

The Organizational Culture Profile of the Participating Agricultural State Universities

Overall, the dominant present and preferred culture of PSAU is Clan Culture (26.05). It was decided by the number of points given to it as shown in Table 2. After Clan Culture is Hierarchy Culture, next is Market Culture, and then finally the Adhocracy Culture. The largest chosen disparity can be seen in Market Culture with a decrease of 1.33 points. Consequently, Clan Culture increases by 1.19 points. Figure 2 illustrates the diagram profile of PSAU which shows that both the blue and red line are more inclined in the Clan side.

ORGANIZATIONAL CULTURE	PRESENT	PREFERRED
Clan	26.05	27.24
Adhocracy	23.25	24.19
Market	24.99	23.66
Hierarchy	25.72	24.91
TOTAL	**100**	**100**

Table 2: *Overall Present & Preferred Culture Profile of PSAU*

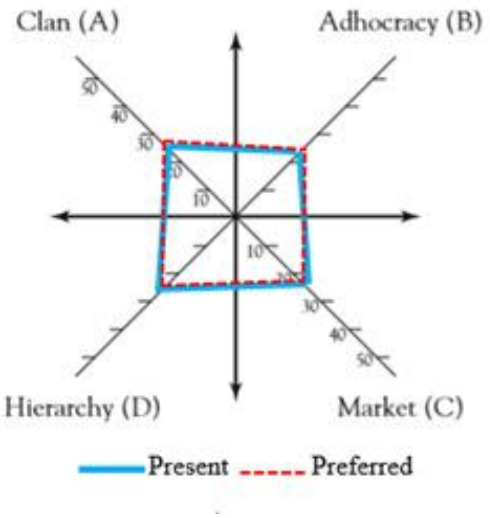

Figure 2: *Overall Present & Preferred Culture of PSAU*

Table 3 shows the tabular data for the overall dominant present culture of TAU is Hierarchy Culture (27.41) followed by Clan, Market, and Adhocracy. The preferred dominant culture is Clan Culture having the largest desired difference with an increase of 1.39 points. Subsequently, Hierarchy Culture decreases by 1.15 points. Figure 3 demonstrates that the present culture is pointed more on Hierarchy while the preferred culture is slanted more on Clan.

ORGANIZATIONAL CULTURE	PRESENT	PREFERRED
Clan	25.54	26.93
Adhocracy	22.18	22.72
Market	24.87	24.08
Hierarchy	27.41	26.26
TOTAL	**100**	**100**

Table 3: *Overall Present & Preferred Culture Profile of TAU*

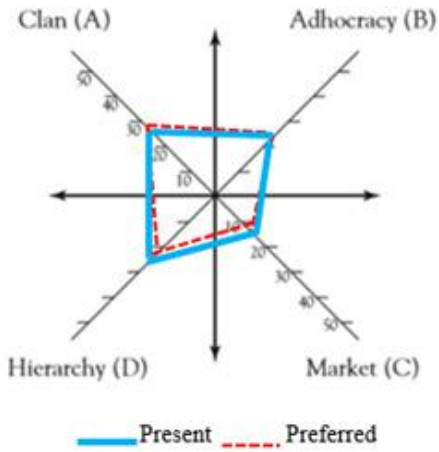

Figure 3: *Overall Present & Preferred Culture Profile of TAU*

ORGANIZATIONAL CULTURE	PRESENT	PREFERRED
Clan	25.55	26.25
Adhocracy	22.47	23.23
Market	25.16	23.77
Hierarchy	26.82	26.74
TOTAL	**100**	**100**

Table 4: *Overall Present & Preferred Culture Profile of Agricultural State Universities in Central Luzon*

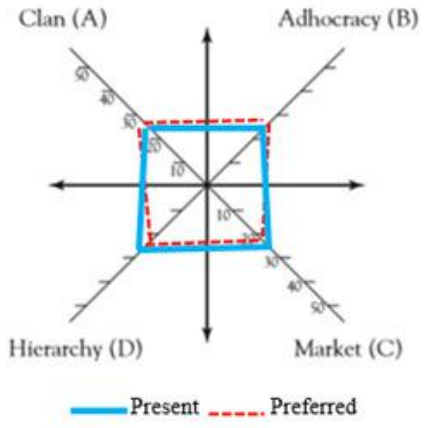

Figure 4: *Overall Present & Preferred Culture Profile of Agricultural State Universities in Central Luzon*

Table 4 represents the combined culture of PSAU and TAU or the Agricultural State Universities in Central Luzon. It demonstrates that the dominant present and preferred culture of the agricultural state universities is Hierarchy Culture (26.82 and 26.74) next is Clan Culture, then Market Culture, and finally Adhocracy Culture. The largest desired difference is apparent in Market Culture with a decrease of 1.39 points. Then, Adhocracy Culture increases by 0.86 points.

Figure 4 displays the inclination towards Hierarchy Culture of the two lines when the answers of both universities were combined. Figure 2, 3, and 4 are illustrations of the 4 cultural archetypes. The blue lines represent the current or present culture, and the broken red lines represent the preferred culture.

Significant Relationship of the Key Dimensions of Organizational Culture to Tangible Improvements

The study revealed that though both are universities providing almost the same service to its constituents but perceived their institution in a different perspective. This part answers the question of the significant relationship of the dimensions of organizational culture, which were used to gauge the dominant culture of the institution to the tangible improvements of the organization.

For the internal stakeholders in Table 5, the dominant characteristics have very significant relationships with all the tangible improvements. In terms of organizational leadership, it is not significant with enrolment and passing percentage in examinations but significant with drop-outs and very significant to graduates and faculty development. Next is management of employees which is very significant to all the dependent variables, followed by organizational glue which is not significant to enrolment and drop-outs but very significant with the three remaining dependent variables. Meanwhile, strategic emphases are not significant to passing percentage in examination but with significance to both enrolment and graduates, and very significant with drop-outs and faculty development. Finally, criteria of success are not significant with drop-outs but possess significant relationship with enrolment and graduates, very significant with passing percentage in examinations and faculty development.

DIMENSIONS OF ORGANIZATIONAL CULTURE	INTERNAL STAKEHOLDERS					
	TANGIBLE IMPROVEMENTS					
	Enrolment	Drop-outs	Graduates	Passing %	Faculty Devt.	OVERALL
1. Dominant Characteristics						
Pearson Correlation	0.243**	0.300**	0.137**	0.227**	0.225**	**0.314****
Verbal Interpretation	Low Correlation	Low Correlation	Negligible Correlation	Low Correlation	Low Correlation	**Low Correlation**
Sig. (2tailed)	0.020	0.004	0.197	0.031	0.032	**0.002**
2. Organizational Leadership						
Pearson Correlation	0.086	0.265*	0.312**	0.165	0.311**	**0.313****
Verbal Interpretation	Negligible Correlation	Low Correlation	Low Correlation	Negligible Correlation	Low Correlation	**Low Correlation**
Sig. (2tailed)	0.415	0.011	0.003	0.118	0.003	**0.003**
3. Management of Employees						
Pearson Correlation	0.334**	0.329**	0.341**	0.421**	0.396**	**0.500****
Verbal Interpretation	Low Correlation	Low Correlation	Low Correlation	Substantial Correlation	Low Correlation	**Substantial Correlation**
Sig. (2tailed)	0.001	0.001	0.001	0.000	0.000	**0.000**
4. Organizational Glue						
Pearson Correlation	0.189	0.190	0.401**	0.317**	0.415**	**0.412****
Verbal Interpretation	Negligible Correlation	Negligible Correlation	Substantial Correlation	Low Correlation	Substantial Correlation	**Substantial Correlation**
Sig. (2tailed)	0.073	0.071	0.000	0.002	0.000	**0.000**
5. Strategic Emphases						
Pearson Correlation	0.216*	0.289**	0.217*	0.192	0.453**	**0.378****
Verbal Interpretation	Low Correlation	Low Correlation	Low Correlation	Negligible Correlation	Substantial Correlation	**Low Correlation**
Sig. (2tailed)	0.040	0.005	0.039	0.068	0.000	**0.000**
6. Criteria of Success						
Pearson Correlation	0.265*	0.070	0.266*	0.270**	0.362**	**0.336****
Verbal Interpretation	Low Correlation	Negligible Correlation	Low Correlation	Low Correlation	Low Correlation	**Low Correlation**
Sig. (2tailed)	0.011	0.511	0.011	0.10	0.000	**0.001**
OVERALL						
Pearson Correlation	**0.267***	**0.290****	**0.335****	**0.319****	**0.435****	**0.452****
Verbal Interpretation	**Low Correlation**	**Low Correlation**	**Low Correlation**	**Low Correlation**	**Substantial Correlation**	**Substantial Correlation**
Sig. (2tailed)	**0.011**	**0.005**	**0.001**	**0.002**	**0.000**	**0.000**

Significant Relationship - * Very Significant Relationship - **

Table 5: *Relationship of the Key Dimensions of Organizational Culture to Tangible Improvements (Internal Stakeholders of PSAU & TAU)*

DIMENSIONS OF ORGANIZATIONAL CULTURE	EXTERNAL STAKEHOLDERS					
	TANGIBLE IMPROVEMENTS					
	Enrolment	Drop-outs	Graduates	Passing %	Faculty Devt.	OVERALL
1. Dominant Characteristics						
Pearson Correlation	0.309**	0.219*	0.309**	0.297**	0.243**	**0.347****
Verbal Interpretation	Low Correlation	Low Correlation	Low Correlation	Low Correlation	Low Correlation	**Low Correlation**
Sig. (2tailed)	0.000	0.013	0.000	0.001	0.006	**0.000**
2. Organizational Leadership						
Pearson Correlation	0.270**	0.267**	0.372**	0.325**	0.328**	**0.398****
Verbal Interpretation	Low Correlation	Low Correlation	Low Correlation	Low Correlation	Low Correlation	**Low Correlation**
Sig. (2tailed)	0.002	0.002	0.000	0.000	0.000	**0.000**
3. Management of Employees						
Pearson Correlation	0.221*	0.342**	0.474**	0.299**	0.305**	**0.429****
Verbal Interpretation	Low Correlation	Low Correlation	Substantial Correlation	Low Correlation	Low Correlation	**Substantial Correlation**
Sig. (2tailed)	0.012	0.000	0.000	0.001	0.000	**0.000**
4. Organizational Glue						
Pearson Correlation	0.421**	0.235**	0.414**	0.349**	0.492**	**0.472****
Verbal Interpretation	Substantial Correlation	Low Correlation	Substantial Correlation	Low Correlation	Substantial Correlation	**Substantial Correlation**
Sig. (2tailed)	0.000	0.007	0.000	0.000	0.000	**0.000**
5. Strategic Emphases						
Pearson Correlation	0.251**	0.251**	0.425**	0.286**	0.411**	**0.410****
Verbal Interpretation	Low Correlation	Low Correlation	Substantial Correlation	Low Correlation	Substantial Correlation	**Substantial Correlation**
Sig. (2tailed)	0.004	0.004	0.000	0.001	0.000	**0.000**
6. Criteria of Success						
Pearson Correlation	0.343**	0.331**	0.389**	0.466**	0.536**	**0.523****
Verbal Interpretation	Low Correlation	Low Correlation	Low Correlation	Substantial Correlation	Substantial Correlation	**Substantial Correlation**
Sig. (2tailed)	0.000	0.000	0.000	0.000	0.000	**0.000**
OVERALL						
Pearson Correlation	**0.385****	**0.347****	**0.505****	**0.427****	**0.493****	**0.546****
Verbal Interpretation	**Low Correlation**	**Low Correlation**	**Substantial Correlation**	**Substantial Correlation**	**Substantial Correlation**	**Substantial Correlation**
Sig. (2tailed)	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Significant Relationship - * Very Significant Relationship - **

Table 6: *Relationship of the Key Dimensions of Organizational Culture to Tangible Improvements (External Stakeholders of PSAU & TAU)*

On Table 6 the external stakeholders' independent variables are very significant with the dependent variables with the exception of: dominant characteristics which is significant to drop-outs, and management of employees which is only significant to enrolment.

The study on the two agricultural state universities' internal and external stakeholders overall revealed that the six (6) dimensions has very significant and substantial correlation to tangible improvements as presented in Table 5 and Table 6 respectively.

Significant Factors that Influence Tangible Improvements

Table 7 shows the predictors of tangible improvements in agricultural state universities in Central Luzon.

PREDICTORS		r-square	Constant	Beta	Sigma
A.	**Enrolment**				
1.	Organizational Glue	0.094	2.271	0.223	0.000[c]
2.	Dominant Characteristics	0.118		0.176	
B.	**Dropouts**				
1.	Management of Employees	0.105	1.679	0.464	0.000[b]
C.	**Graduates**				
1.	Management of Employees	0.172	1.745	0.268	0.001
2.	Organizational Glue	0.211		0.242	
D.	**Passing Percentage in Examinations**				
1.	Criteria of Success	0.135	1.949	0.257	0.000[c]
2.	Management of Employees	0.173		0.235	
E.	**Faculty/Staff Development**				
1.	Organizational Glue	0.208	1.611	0.293	0.000[b]
2.	Criteria of Success	0.251		0.281	

Table 7: *Factors that Influence Tangible Improvements*

Enrolments

The result reveals that the predictors for enrolment are organizational glue and dominant characteristics when an accumulated probability of 11.8%. Independently, organizational glue can predict or influence enrolment by 9.4 % while dominant characteristics can influence only the enrolment by 2.4 %. Organizational glue has greatest influence on enrolment because separately the r – square of organizational glue is higher than the r – square of dominant characteristics. The regression coefficients of organizational glue (B =0.223) and dominant characteristics (B = 0.176) reveal that for each unit change in organizational glue enrolment will be affected by 0.223 while for every unit change of enrolment, dominant culture would have an effect of 0.176. If organizational glue is written as x_1, and dominant characteristics as x_2, by using their coefficients, a regression equation could be created as follows:

$$\text{Enrolment} = 0.223x_1 + 0.176x_2 + 2.271$$

This equation can be applied to calculate the influence of organization glue and dominant characteristics to enrolment.

Drop-outs

For drop-outs, its predictor is management of employees. It can influence the drop-outs by 10.50 %. For every unit of change in management of employees, drop-outs will be affected by 0.464. If management of employees is written as x_3, a regression equation could be transcribed as follows:

$$\text{Drop-outs} = 0.464x_3 + 1.679$$

Graduates

The influencers of graduates are management of employees and organizational glue when an accumulated probability of 21.10 %. Alone, Management of employees can predict graduates by 17.2 % while organizational glue can influence only the graduates by 3.9 %. Management of employees have the most influence to graduates because independently the r – square of management of employees is greater than the r – square of organizational glue. The regression coefficients of management of employees (B = 0.268) and organizational glue (B =0.242) reveal that for every unit change in management of employees graduates will be affected by 0.268 while for every unit change of graduates, organizational glue would have an effect of 0.242. If management of employees is written as x_3, and organizational glue as x_1, a regression equation could be written as follows:

$$\text{Graduates} = 0.268x_3 + 0.242x_1 + 1.745$$

Passing Percentage in Examinations

For the passing percentage in examinations the predictors are criteria of success and management of employees' procurement and selling of goods and monitoring when an accumulated probability of 17.3%. Individually, criteria of success can influence greatly the passing percentage in examinations because of its highest r – square at 13.5 % as compared to the r – square of management of employees at 3.8%. For every unit change of criteria of success, passing percentage in examination will be affected by 0.257 and 0.235 respectively. The equation that can predict or influence the passing percentage is:

Passing percentage in examinations = $0.257x_4 + 0.253x_3 + 1.949$

Faculty/Staff Development

Finally, the result reveals that the predictors for faculty/staff development are organizational glue and criteria of success when an accumulated probability of 11.8 %. Individually, organizational glue can predict or influence faculty/staff development by 20.8 % while criteria of success can influence only the faculty/staff development by 4.3 %. Organizational glue has greatest influence on faculty/staff development because separately the r – square of organizational glue is higher than the r – square of criteria of success. The regression coefficients of organizational glue (B =0.293) and dominant characteristics (B = 0.281) reveal that for every unit change in organizational glue faculty/staff development will be affected by 0.293, while for every unit change of faculty/staff development, criteria of success would have an effect of 0.281. If organizational glue is written as x_1, and criteria of success as x_4, by using their coefficients, a regression equation could be written as follows:

Faculty/staff development = $0.293x_1 + 0.281x_4 + 1.611$

This equation can be employed to calculate the influence of organization glue and criteria of success to faculty and staff development.

Conclusion

The respondents are generally female, in their early middle age, with the highest frequency of 74 or 33.79 % accumulated by the age group 36 – 45. For the marital status, most of the respondents are married with 170 that have at least one dependent. When highest educational attainment is concern 76 are college graduate for both external and internal stakeholders, however, 42 respondents belong to the non-teaching staff of the university while 37 external stakeholders are jobless. From the summarized results, the following conclusions were drawn:

1. Pampanga State Agricultural University has a present and preferred dominant Clan Culture. Founded on the interpretation of OCAI (Cameron & Quinn, 2011) the respondents currently viewed the university as a controlled and structured place. Formal procedures generally govern what people do. Leaders are generally considered to exemplify mentoring, facilitating or nurturing characteristics. PSAU is characterized by teamwork, consensus and participation. To maintain the smooth-running organization, which is important to the university formal rules and policies serve as glue that holds the agricultural state university together. The university emphasizes competitive actions and achievement that is why they define success on the basis of efficiency. The difference between the preferred and present organizational culture of PSAU is evident in the strategic emphases and criteria of success , in which several years from now the respondents aspired PSAU to put emphasis on human development where high trusts, openness, and participation persist that will eventually lead to institutional success.
2. The study tells that TAU's organizational culture at present is Hierarchy though the stakeholders preferred a Clan Culture in the coming years. Presently, the study revealed that TAU like PSAU is also a controlled and structured place. Leaders or administrators of the agricultural university are

considered to be coordinators and organizers. Security of employment, conformity, predictability in relationships valued more together with emphasis on achievement, goal accomplishment, permanence and stability that will eventually lead the success in the marketplace. However, in the future they opt to have a leader that exemplifies entrepreneurship, innovation, and risk taking that supports their idea on success characterized on the foundation of efficiency.

3. Overall present and preferred culture for the agricultural state universities is Hierarchy . The study reveals that PSAU have cultural congruence in 4 out of 6 aspects namely: dominant characteristics, organizational leadership, management of employees, and organizational glue. In TAU all aspects are culturally congruent except for organizational leadership. For the combination of both agricultural state universities there are cultural incongruence specifically in Organizational Glue and Strategic Emphases. Cameron (2004) stressed that organizations with congruent culture (same) are often successful. There are fewer inner conflicts and contradictions. However cultural incongruence encourages an awareness of the necessity of change.

4. The dimensions of organizational culture are all with very significant relationship and substantial correlation to tangible improvements thereby rejecting the null hypothesis. It also proved that management of employees and organizational glue influenced most of the tangible improvements while organizational leadership and strategic emphases impact none of the dependent variables.

The recommendations below are herewith addressed and forwarded taken from the from the aforementioned conclusions.

1. Congruence means that the dimension is placed at the same cultural quadrant. Change is often encourage once there is cultural incongruence. In the case of the agricultural state universities PSAU must look at its strategic emphases and criteria for success while TAU should assess its organizational leadership. Cameron and Quinn lay to the notion that urgent action is necessary if the disparity between the present and preferred culture for every dimension is higher than 10 points, which is not valid for PSAU and TAU. However, the incongruity generates crucial information about any needed changes and which direction should the organization moved in.

2. The universities should maintain and give more emphasis on the dimension of organizational culture which pertains to management of employees and organizational glue since these two affects most of the tangible improvements.

3. Other researchers to conduct future studies/research in organizational culture.

References

Ashipaoloye, F.K. (2014). A comparative analysis of the organizational culture and employee's motivation of selected cities in CALABARZON: Basis for employee's motivation, leadership and innovative management. Asia pacific Journal of Multidisciplinary Research, 2(5), 54-63.

Beach, L.R. (2006). Leadership and the art of change. A practical guide to organizational transformation. Thousand Oaks, California: Sage Publications, Inc.

Cameron, K.S. & Quinn R. E. (2006). Diagnosing and changing organizational culture. Jossey-Bass, San Francisco, CA.

Cameron, Kim S., Bright, David, and Caza Arran. (2004) Exploring the Relationships Between Organizational Virtuousness and Performance. American Behavioral Scientist.

Carpenter, D. (2015). School culture and leadership of professional learning communities. International Journal of Educational Management, 29(5), 682-694. doi:10.1108/IJEM-04-2014-0046

Coman, A. and Bonciu C. (2016). Organizational culture in higher education: learning from the best. European Journal of Social Sciences Education and Research, 6(1).

Dalanon, J. et al. (2018). A Philippine rural school organizational climate, teachers' performance, and management competencies. International Journal of Research-Granthaalayah, 6(1), 248-265. doi:10.5281/zenodo.1164141

Hoy, W.K. (1990). Organizational Climate and Culture: A Conceptual Analysis of the school workplace.

Lundy, O. and Cowling, A. (1996), Strategic Human Resource Management. Routledge, London.

Kalaw, J.K. (2014). Organizational culture among teaching employees of Lyceum of the Philippines University-Batangas: Basis for enhancement. International Journal of Information, Business and Management, 6(4), 52-66.

Martins E.C. and Terblanche F. (2003). Building organizational culture that stimulates creativity and innovation. European Journal of Innovation and Management, 6(1), 64-74. doi 10.1108/14601060310456337

McMurray, A.J. (2003). The relationship between organizational climate and organizational culture. Journal of American Academy of Business, 3(1/2), 1-8.

McNay, I. (1995). Universities going international: choices, cautions and conditions, In P. Blok (Ed.), Policy and Policy Implementation in Internationalisation of Higher Education. Amsterdam: EAIE, 35-40. ISBN: 9074721052 (pbk) 0927-3514.

Mendoza, R.O, J.M. Laguador, and Buenviaje, M.G. (2014). Organizational satisfaction and work engagement among non-teaching personnel of an Asian university. Asian Journal of Management Sciences and Economics, 1(1), 12-22.

Novikova, Ye.Yu. (2012). The organizational culture of a higher education institution as rated by its students. Alma Mater, 12, 29 – 33

Mendoza, R.O, J.M. Laguador, and Buenviaje, M.G. (2014). Organizational satisfaction and work engagement among non-teaching personnel of an Asian university. Asian Journal of Management Sciences and Economics, 1(1), 12-22.

Quinn, R. E. & Rorbaugh, J. (1983). A spatial model of effectiveness criteria: Towards a competing values approach to organizational analysis. Management Science, 29, 363-377.

Sathe, V. (1985), Culture and related corporate realities: text, cases and readings on organizational entry, establishment, and change. Irwin, Homewood, IL.

Schein, E.H. (1985). Organizational culture and leadership. Jossey-Bass, San Francisco, CA.

Schneider, B., Ehrhart, M.G., & Macey, W.H. (2013). Organizational Climate and Culture. Annual Review of Psychology.

Vasyakin, B. S., Ivleva, M. I., et al. (2016). A study of the organizational culture at a higher education institution. International Journal of Environmental & Science Education, 11(10) Retrieved from http:// www. research gate.net>-publication.

Weatherly, K.A., & Beach, L.R. (1996). Organizational culture and decision making. In L.R. Beach (Ed), Decision making in the workplace: A unified perspective. Mahwah, NJ: Erlbaum.

Our history. Retrieved September 20, 2018, from http://www.psau.edu.ph/homepage

History of Tarlac Agricultural University. Retrieved September 10, 2018, from http://www.tau.edu.ph/index.php/about-tau/history

INEXPENSIVE DEMONSTRATIONS AND EXPERIMENTS IN UNDERSTANDING BASIC CONCEPTS OF FLUID MECHANICS

Berma O. Patron and Antonia Gueyndoline B. Despojo
Foundation University, Dumaguete City
Volume 5, Issue No.1, January - December 2020

Abstract

This descriptive-qualitative study determined student performances on the basic concepts of fluid mechanics before and after using locally made set-ups in inexpensive demonstrations and experiments. The set-ups and questionnaires were utilized and validated, and the hypothesis was tested using accuracy, standard deviation, mean, and t-test for dependent data. Results showed that measurements obtained from the locally made set-ups were close to the accepted value and not scattered and were able to exhibit the theory of each concept; however, systematic and random errors may have occurred during the conduct of the experiment. Moreover, the study revealed a significant difference that exists between the students' pretest and posttest performances and implied that utilization of the localized set-ups enabled the students to remember, understand, apply, and analyze the basic concepts of fluid mechanics that made them obtained better scores in the posttest.

Keywords:

Conceptual understanding, fluid mechanics, improvisation, K-12

Introduction

Since the implementation of the Kinder-12 (K-12) curriculum in the Philippines, spiral progression approach is applied across all subjects that entails concepts to be taught at a progressing difficulty as the learner proceeds to the next grade level. In line with this, science is tackled elaborately in science-related strands in the senior high school curriculum which encourages practical works such as field works or laboratory activities. Yet not all the 5, 359 secondary public schools in the Philippines have Science laboratories. The ratio is 1,325 students to 1 laboratory room and not all these laboratories contain enough equipment. This makes students lose their interest towards learning science (Visperas, 2011). Although the government has provided for basic science and math equipment to a number of recipient public secondary schools through DepEd Order 45 series of 2013, there is still a problem that lies within the nature of such equipment; most of them cannot cater to most of the topics in Physics. The subject involves and requires the use of pieces of apparatus that will help in concretizing concepts for better understanding and comprehension. This problem is emphasized in Orlean's (2007) study which evaluated the state of Physics education in secondary schools of the Philippines and results included that there are limited instructional materials and technologies in the country, and even internationally (Aina, 2013).

One of the core concepts in Physics is fluid mechanics which deals with understanding how fluids flow. There are five concepts inclusive to fluid mechanics covered in this study namely, Archimedes' principle, specific gravity, Pascal's principle, continui-

ty equation, and Bernoulli's principle. These are essential topics or concepts to those learners aspiring to be engineers, doctors, nurses, and the like. The manner of teaching such concept involves both lecture and laboratory work. If not, students will have a difficult time of grasping and applying the concepts to real life situations, which will reflect on the science education quality that Filipino students are getting specially those schools that are situated in rural areas that do not have any science laboratories (The Manila Times, 2014). The end goal is to augment or improve the conceptual understanding of students on various topics in Physics because through conceptual understanding, students are able to get ideas better, thus allowing them to transfer what they have learned into different subjects or endeavors, concepts are not easily forgotten by the learners, and it allows the attainment of high student engagement, student collaboration and metacognition and higher-order thinking skills (Omari & Chen, 2016; Schwartz 2010; Learn Implement Share, 2017).

The importance of laboratory work to conceptual understanding is emphasized by David Kolb's Experiential learning theory wherein it explains that learning is a process of creating knowledge through transferring experience (Kolb, 1984). The learner encounters a new experience of a situation (McLeod, 2013) and the integration of procedural knowledge with conceptual knowledge will result to conceptual understanding (Rittle – Johnson & Star, 2017). Ross & Wilson (2012) further suggested that a good foundation of factual knowledge and procedural knowledge is important for conceptual understanding to occur. The learner can reflect about the new experience and can focus on any inconsistencies between what he understood and what he has experienced; he constructs a model or a theory about what he was able to observe and experienced and attempts to test the previously constructed model or theory and apply it to real world situations to see what will be the result (JL, 2007; McLeod, 2013).

There are also conditions that may have an indirect influence on the attainment of conceptual understanding namely meaningful learning, misconceptions, and memorization (Mills, 2016). To further explain, meaningful learning happens when students are exposed to activities that allow them to make sense of what they have learned and consequently apply it to real-life situations; misconceptions are errors on student's cognitive structure about a concept; and memorization encourages surface learning and obstructs students from learning and deep thinking about a subject (Ironside, 2005).

Considering such ideas on experiential learning and conceptual understanding, alternatives to costly science equipment are being put under the spotlight because low-cost pieces of apparatus that can be constructed from locally available materials can be a source of learning enhancement and skill development. In comparison to standard factory laboratory apparatus, locally made apparatus provides an alternative learning experience for financially challenged science classrooms (Yitbarek, 2012) and they can be repaired easily because the materials are accessible and mostly made from scraps (Tubog, 2013). There have been several experiments or studies that support or have done investigations on the use of improvised or locally made apparatuses that help students understand difficult physics concepts.

In Yale University (2011), an experiment was done in order to help students understand a number of scientific concepts in undergraduate physics that are often ignored due to its difficulty such that through the ex-

periment, the students will be able to visualize and quantifiably study the instability in fluid flow. Courbin, Cristobal, Winckert, & Panizza (2005) discussed the limitations and advantages of their easy to use and inexpensive apparatus and compared it to other classical techniques which is a Zimm–Crothers viscometer and it is a great tool for undergraduate laboratory courses that explains electromagnetism and fluid mechanics principles. A Venturi nozzle and Pipe Flow experiments, which are portable and inexpensive, have generated results that showed students have enjoyed such experiments and have strengthened their understanding of the different key concepts of fluid mechanics (Richards, Meng, Van Wie, Golter, & Richards, 2015).

Positive effects on student performance and achievement levels due to their use of locally made or improvised instructional materials for understanding concepts in Physics have been revealed by several studies as well. Kishore (2009) conducted a study at an Indian state called Rajasthan and revealed good results after one year of intensive implementation which included a significant improvement in the achievement levels of the project schools as well as being innovative using materials that are readily available. C Nwike & Catherine (2013) showed in their study that those who were taught with instructional materials had a better performance compared to those who were not taught with instructional materials. Oladejo, Olosunde, Ojebisi, and Isola (2011) strengthened such results with their own study wherein they showed that a significant difference exists in students' achievement using standard factory apparatus, improvised apparatus, and conventional instruction wherein students who were taught using the improvised apparatus have achieved the highest achievement score on post-test.

It is evident by these studies that low-cost apparatuses are helpful; and accuracy and consistency of data acquired from such set-ups are suggested to be considered with great care because it is very important to keep all data as accurate as possible since this will ensure the integrity of any research (Faculty Development and Instructional Design Center) and that reliable analytical standards is a must (Creamer et. al., 2009). If the accuracy level of data is low, this would lead to incorrect insights or understanding of what the data is trying to reveal and poor results will then be inevitable (Cotton, 2014). Macfarlan (2015) claims that it is imperative to be consistent throughout the whole process of collecting data, especially across distributed data (Microsoft, 2014).

In this study, the researchers intended to devise experiments that utilize available materials that will work in demonstrating as set-ups which cost lesser than their standard factory counterparts and to identify if there is any difference on the students' conceptual understanding of fluid mechanics before and after their use of the set-ups. It further considered and tested the accuracy and consistency of the locally made set-ups as well as the questionnaires.

CONCEPTUAL FRAMEWORK

The study focused on the creation and utilization of inexpensive set-ups for demonstrations and experiments which make use of locally available materials to help students understand and concretize the concepts of fluid mechanics. Figure 1 is presented below for visual representation of the flow of the study and shows an input, a process, and an output. The input were the experiment and construction guides for each concept of fluid mechanics which are taught in General Physics 1, a specialized subject for the Science, Technology, Engineering,

and Mathematics (STEM) strand in the Senior High level. The process included a pretest, the inexpensive set-ups for demonstrations and experiments, and a post-test. The output, then, was students' improved understanding of the basic concepts of fluid mechanics.

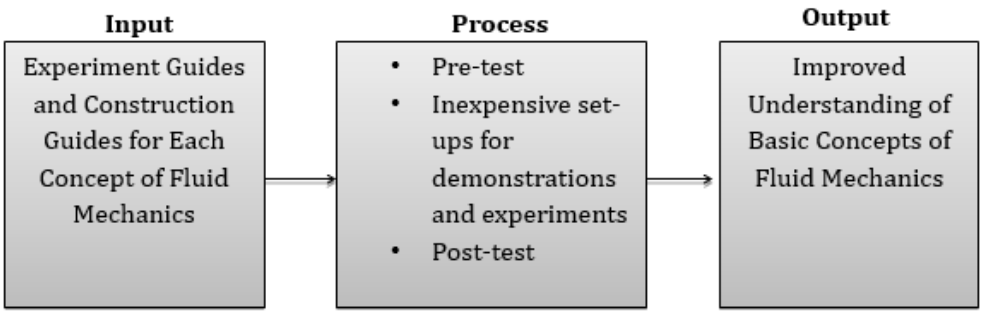

Figure 1: *Conceptual Framework of the Study*

METHODS AND DESIGN

Data and Respondents

The study utilized cluster sampling to determine the students who would participate in this study from a specific section; they are Grade 12-STEM students from a private secondary school in Negros Oriental. These are the students (n=44) who have already taken up their General Physics 1, which is a specialized subject in their strand.

In gathering the data, the researchers constructed locally made set-ups and devised inexpensive demonstrations and experiments to facilitate understanding of basic concepts of fluid mechanics. The data gathered from the experiments were computed and compared to the standard value or theoretical value to check if the set-ups were accurate and consistent. Pretest and posttest questionnaires about the basic concepts of fluid mechanics were also constructed by the researchers based on a Table of Specification (see tables one and two) and were administered to the students upon approval of the school's superintendent and subject teacher.

Table 1: *Table of Specification for Pre-Test*

TOPIC	LEVEL of ASSESSMENT						Number of Items	Percentage
	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating		
Fluid Mechanics I. Archimedes' principle	1, 2, 4	3		5, 6, 7, 8, 9, 10			10	20%
II. Specific gravity	11, 12, 16	13, 14	17, 18, 19, 20	15			10	20%
III. Pascal's law	21, 22, 23, 24	25, 26		27, 28, 29, 30			10	20%
IV. Bernoulli's principle	31, 34, 40	32, 33, 35, 37, 38, 39	36				10	20%
V. Continuity equation	42	41, 43, 49, 50	46, 47, 48	44, 45			10	20%
Total Items	14	15	8	13			50	100%
Percentage	28%	30%	16%	26%			100%	100%

Table 2: *Table of Specification for Post-Test*

TOPIC	LEVEL of ASSESSMENT						Number of Items	Percentage
	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating		
Fluid Mechanics I. Archimedes ' principle	1, 3, 4	2		5, 6, 7, 8, 9, 10			10	20%
II. Specific gravity	13, 14, 16	11, 12	17, 18, 19, 20	15			10	20%
III. Pascal's law	21, 22, 25	23, 24		26, 27, 28, 29			10	20%
IV. Bernoulli's principle	32, 33, 36	31, 34, 35, 37, 38, 39	40				10	20%
V. Continuity equation	41	42, 45, 46, 47	48, 49, 50	43, 44			10	20%
Total Items	14	15	8	13			50	100%
Percentage	28%	30%	16%	26%			100%	100%

The basic concepts of fluid mechanics assessed by the researchers prior to and after using the locally-made set-ups are: (1) Archimedes' principle; (2) specific gravity; (3) Pascal's law; (4) Bernoulli's principle; and (5) continuity equation. The pre-test and post-test items were the same only that placement of the items under each concept in the post-test is jumbled to really assess students' progress.

The researchers sought help from experts in validating the test items and a dry-run was conducted of the test questionnaire to thirty (30) respondents that were not included in the list of final respondents. The tallied results were computed for reliability. The reliability coefficients in Archimedes Principle, specific gravity, Pascal's principle, Bernoulli's principle, and continuity equation were 0.82, 0.73, 0.75, 0.80 and 0.78, respectively.

Data Treatment

Determining the accuracy of the results using the locally made apparatus in demonstrating the set-ups during the conduct of the experiment on fluid mechanics,

the researchers keenly facilitate and observe the closeness of the measurements obtained by the students and compared it to the theoretical value reflected in physics books. The researchers used statistical tools to test the hypotheses. These include (1) standard deviation, used to determine the consistency of the data from the students' use of the locally made set-ups during the demonstrations and experiments, (2) mean, used in getting the extent of performance of the students during their pretest and posttest, and (3) t-test for dependent data, used to identify the significant difference between the pretest and posttest performance of the students. It was utilized since the data were in ratio scale. The proficiency level or academic performance at which the students were performing was based on the criteria set in DepEd Order No. 8, s 2015 which has five indicators with the following verbal equivalent based on the ratings: Outstanding (90% and above), Very Satisfactory (85%-89%), Satisfactory (80%-84%), Fairly Satisfactory (75%-79%), and Did Not Meet Expectation (74% and below).

RESULTS

Accuracy and Consistency of the Inexpensive Demonstrations and Experiments

Tables 3 to 7 show the comparison for accuracy and consistency of the experiment for Archimedes' principle, specific gravity, Pascal's principle, Bernoulli's principle, and continuity equation. The data revealed the following results for the five (5) topics included in fluid mechanics, (1) the students have a lesser percentage error of 20.97 for Archimedes' principle set-up; (2) for Specific gravity, a lower percentage error was obtained which was 0.98; (3) for Pascal's principle, 90% portrayed equal measurements for all straws, (4) for Bernoulli's principle, it had successfully portrayed the inverse relationship between speed and pressure and finally for (5) continuity equation, both the researchers and students obtained results that are almost 100% accurate in portraying the theory. The accuracy of measurements obtained from each set-up is close to the accepted value for each topic which implies that the set-ups have exhibited the theory of each concept.

Further, the set-up for (a) Archimedes' principle had a standard deviation of 3.18 from the researchers and 8.85 from the students, however systematic and random errors occurred during the students' experiments such as instrument resolution, failure to check zero of instrument, and also parallax; for (b) Specific gravity had a standard deviation of 0.11 from the researcher and 0.53 from the students with random errors such as parallax and incomplete definition; for (c) Pascal's principle had results that were close to each other, for (d) Bernoulli's principle had measurements that are close to each other, from both the researchers and the students; and for (e) Continuity equation had results that were close to each other with a random error called incomplete definition. The measurements obtained from each set-up for each experiment and demonstrations are close to each other, although some systematic and random errors occurred.

Table 3: *Data Comparison for Accuracy and Consistency of the Experiment for Archimedes' Principle*

Trial	Volume of displaced water (ml)		Volume of right circular cone (cm^3) (Accepted Value)	
	Researcher	Students	Researcher	Students
1	28	34.9	48.4	48.4
2	23	46.4	48.4	48.4
3	34	40.5	48.4	48.4
4	28	30	48.4	48.4
5	28	56.2	48.4	48.4
6	31	39	48.4	48.4
7	32	30	48.4	48.4
8	27	29	48.4	48.4
Average	**28.88**	**38.25**		
Percent error	**40.34**	**20.97**		
Standard deviation	**3.18**	**8.85**		

Table 4: *Data Comparison for Accuracy and Consistency of the Experiment for Specific Gravity*

Trial	Specific gravity		Accepted Value of the Specific gravity of cooking oil
	Researcher	Student	
1	1.01	0.57	0.917
2	1	0.93	0.917
3	0.79	0.57	0.917
4	0.73	0.73	0.917
5	0.96	0.61	0.917
6	0.84	0.73	0.917
7	0.76	1.03	0.917
8	1.04	1.73	0.917
9	0.98	2.1	0.917
10	0.97	1.63	0.917
Average	**0.908**	**1.063**	
Percent error	**0.98**	**15.92**	
Standard deviation	**0.11**	**0.53**	

Table 5: *Data Comparison for Accuracy and Consistency of the Demonstration for Pascal's Principle*

Trial	Straws							
	Green (5mm)		Transparent (6 mm)		Transparent (11 mm)		Equal or Unequal	
	Researcher	Student	Researcher	Student	Researcher	Student	Researcher	Student
1	40	45	40	45	40	45	Equal	Equal
2	50	81	50	81	50	81	Equal	Equal
3	55	78	55	78	55	78	Equal	Equal
4	68	98	68	98	68	98	Equal	Equal
5	93	116	90	110	95	118	Unequal	Unequal
6	80	79	80	72	80	78	Equal	Unequal
7	90	110	90	100	90	100	Equal	Unequal
8	65	94	65	93	65	94	Equal	Unequal
9	40	95	40	95	40	95	Equal	Equal
10	35	70	35	70	35	60	Equal	Unequal
							90% Equal	*50% Equal*

Legend: ***Equal*** *refers to the equal measurements obtained from the rise of water in the straws of different diameters when force is applied and there is a change in pressure inside the straws.*

Unequal *refers to the unequal measurements obtained from the rise of water in the straws of different diameters when force is applied and there is a change in pressure inside the straws.*

Table 6: *Data Comparison for Accuracy and Consistency of the Demonstration for Bernoulli's Principle*

	Distance (cm)		Average Time (s)		Average Pressure (kg/cm²)		Speed (cm/s)	
	Researcher	Student	Researcher	Student	Researcher	Student	Researcher	Student
1. Topmost point of the pump to line A	7	7	2.208	1.572	0	0	3.17	4.45
Standard deviation	*0.00*	*0.00*	*0.74*	*0.67*	*0.00*	*0.00*		
2. Topmost point of the pump to line B	14	14	4.572	1.921	0	0	3.06	7.28
Standard deviation	*0.00*	*0.00*	*0.94*	*0.54*	*0.00*	*0.00*		
3. Topmost point of the pump to line C	21	21	7.34	2.4	0	0.03	2.86	8.7
Standard deviation	*0.00*	*0.00*	*1.94*	*0.90*	*0.00*	*0.04*		
4. Topmost point of the pump to line D	28	28	9.993	2.897	0.11	1.17	2.8	9.67
Standard deviation	*0.00*	*0.00*	*2.62*	*1.26*	*0.07*	*0.21*		

Table 7: *Data Comparison for Accuracy and Consistency of the Demonstration for Continuity Equation*

Trial	In which of the two tubes did water come out the fastest? With tube diameter of 6mm (Container 1)		With tube diameter of 18mm (Container 2)	
	Researcher	Student	Researcher	Student
1	✓			✓
2	✓	✓		
3	✓			✓
4	✓	✓		
5	✓	✓		
6	✓	✓		
7	✓	✓		
8	✓	✓		
9	✓	✓		
10	✓	✓		
Percentage	**100%**	**80%**		**20%**

Legend:

✓ represents the result of the trial as to which of the containers with tubes of different diameters did the water come out first.

Performance of the Students on the Basic Concepts of Fluid Mechanics

The data in figure 2 reflect the pretest performance of the students on the basic concepts of fluid mechanics before using the inexpensive set-ups in performing laboratory experiments and demonstrations and results reveal that in all five topics included in the pretest on the basic concepts of fluid mechanics the students' performance did not meet expectations with specific gravity having the lowest rating (66.94) which means that the students, at this level without the aid of the set-ups or instructional materials, struggle with remembering, understanding, applying and analyzing the basic concepts of fluid mechanics and the skills of the students have not been developed to mitigate such struggle. This can be attributed to students' lack of knowledge and skills on the basic concepts of fluid mechanics.

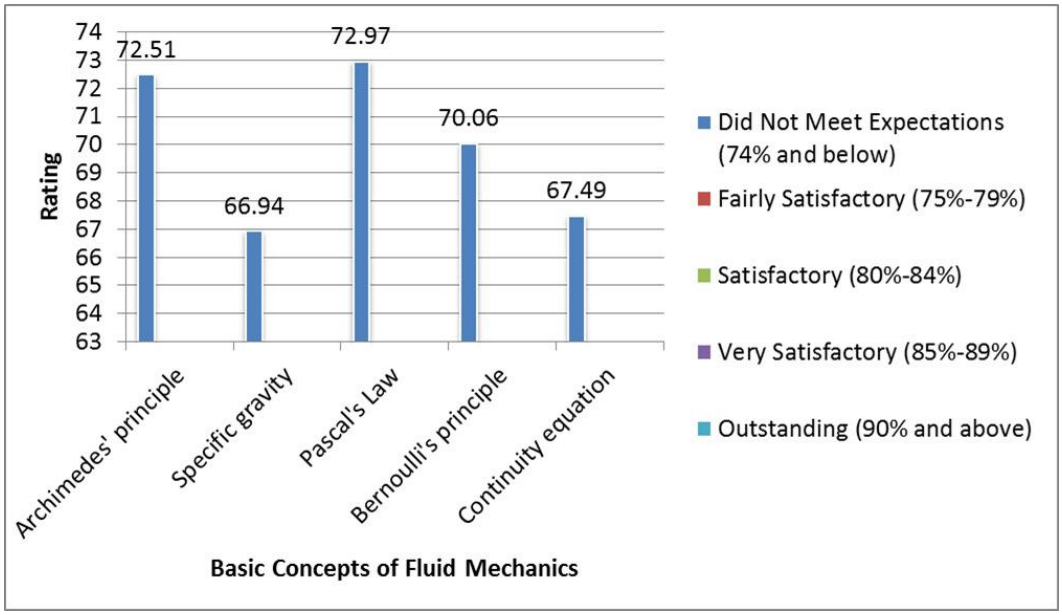

Figure 2: *Pretest performance of the students on the basic concepts of fluid mechanics*

Figure 3 reveals that the students' posttest performance for Pascal's principle is outstanding (92.09), satisfactory for Archimedes' principle (82.83), specific gravity and continuity equation (80.09), and satisfactory for Bernoulli's principle (76.77). Satisfactory performance means that the students can now remember, understand, apply and analyze the concepts for these topics with little aid from teachers and peers and transfer such learning to written and performance tasks; while, fairly satisfactory performance indicates that they possess minimum knowledge, such as remembering, understanding, applying and analyzing its concepts but still needs assistance in exhibiting such learning in written and performance tasks. Lastly, outstanding performance reveals that they exceed the core requirements in terms of remembering, understanding, applying, and analyzing its concepts, and can transfer such learning automatically and flexibly through written and performance tasks. The marked improvement of the students' performance in the posttest may be attributed to their use of the inexpensive set-ups in the demonstrations and experiments for the basic concepts of fluid mechanics.

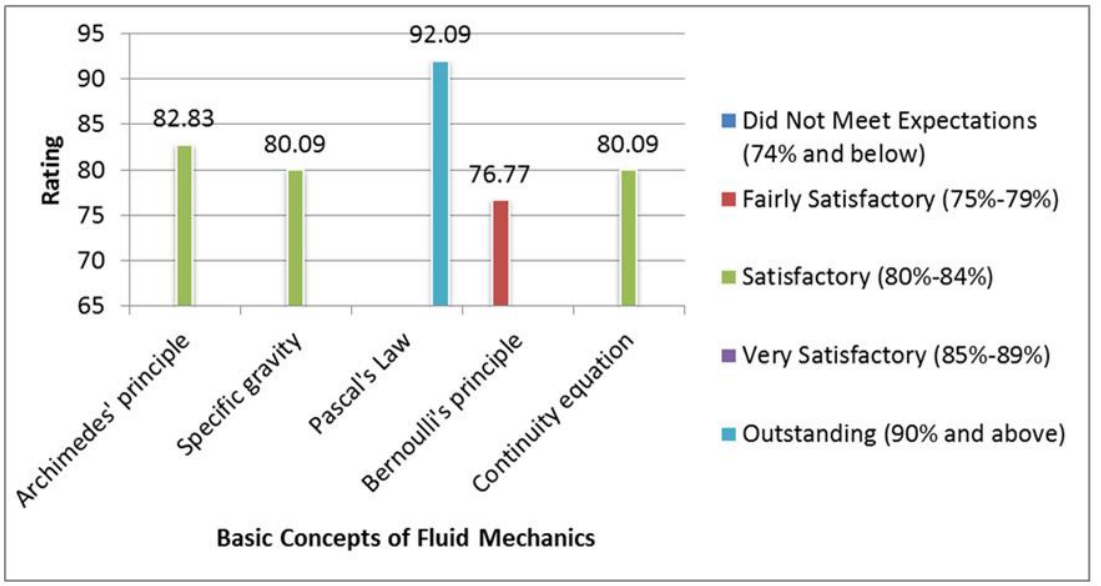

Figure 3: *Posttest performance of the students on the basic concepts of fluid mechanics*

Table 8 reflects that all posttest performances of the students are greater than their pretest performances with all the p-values being less than the level of significance (0.05) which leads to the rejection of the null hypothesis. This reveals that there is a significant difference between pretest and posttest performances of students on the following topics: (a) Archimedes' principle (10.32); (b) Specific Gravity (13.15); (c) Pascal's principle (19.12); (d) Bernoulli's principle (6.71); and (e) Continuity equation (12.6). The results imply that the use of inexpensive experiments have contributed to the students' knowledge of the concepts in such a way that the set-ups have exhibited the theories of each topic and is one of the many factors that have helped the students to remember, understand, apply, and analyze the concepts that made them obtain outstanding, satisfactory, and fairly satisfactory scores in the posttest.

Table 8: *Difference in the Pretest and Posttest Performances of the Students on the Basic Concepts of Fluid Mechanics*

Topics	Pretest	Verbal Equivalent	Posttest	Verbal Equivalent	Difference	t-value	p-value	Decision	Remarks
Archimedes' Principle	72.51	Did not meet expectations	82.83	Satisfactory	10.32	6.023	0.000	Reject H_{o1}	Significant
Specific gravity	66.94	Did not meet expectations	80.09	Satisfactory	13.15	10.168	0.000	Reject H_{o1}	Significant
Pascal's Law	72.97	Did not meet expectations	92.09	Outstanding	19.12	12.166	0.000	Reject H_{o1}	Significant
Bernoulli's Principle	70.06	Did not meet expectations	76.77	Fairly Satisfactory	6.71	5.693	0.000	Reject H_{o1}	Significant
Continuity Equation	67.49	Did not meet expectations	80.09	Satisfactory	12.6	5.562	0.000	Reject H_{o1}	Significant

Level of Significance = 0.05

DISCUSSION

The primary focus of this study was to determine the difference in the performances of the students before and after participating in the inexpensive demonstrations and experiments about the basic concepts of fluid mechanics. With this, the researchers would be able to reveal if the inexpensive demonstrations and experiments will really make a significant influence in the students' extent of understanding of the concepts. Further, the researchers took into consideration the accuracy and consistency of the measurements obtained from the locally made set-ups.

The study indicated that the measurements obtained from each set-up for the experiments and demonstrations were close to the accepted value and were close to each other for each topic, which implied that the set-ups have exhibited accuracy and precision in demonstrating the theory and principles behind each concept, although some systematic and random errors occurred. The pretest performance of the students on the basic concepts of fluid mechanics did not meet expectations but had a marked improvement in their posttest after their use of the set-ups in the inexpensive demonstrations and experiments. This showed that there is a significant difference that exists between the pretest and posttest performances of the students in all topics on the basic concepts of fluid mechanics which indicated that the inexpensive demonstrations and experiments have helped in improving the students' understanding and helped them gain better scores in the posttest.

These results, which reflect improve-

ment in the students' performance on the five topics for fluid mechanics after the use of the inexpensive set-ups, is similar with Kishore's (2009) study on the use of low-cost science experiments to the development of science experiences for students which attained results that included a significant improvement in their achievement levels.

It also has similarity to a study which revealed that students who were taught using improvised apparatus have achieved highest achievement scores on post-test (Oladejo, Olosunde, Ojebisi, and Isola, 2011). Secondary schools should incorporate the use of instructional materials because it has a positive effect on the performance of the student as suggested and recommended by C Nwike and Catherine (2013) in their study.

On the other hand, the study is limited to specific concepts of fluid mechanics and used a test questionnaire to measure the extent of conceptual understanding before and after their use of the set-ups and the researcher did not have any control on the honesty of the answers of the students as well as their intrinsic motivation to engage in the classroom activity. Further, locally made set-ups cannot compare to the accuracy of standard factory apparatuses, but the theory can still be demonstrated by such set-ups. Also, the skills and experience of the students in handling or performing procedures in an experiment poses a limitation to attaining very accurate and consistent measurements, thus it can be considered as a limitation of the study. It is then recommended that teachers will actively engage students to more laboratory classes and experiments to develop their knowledge and skills in scientific measurements and procedures to lessen systematic and random errors. Further, in the conduct of more experiments in Physics which make use of locally made set-ups or apparatuses, calibration of these apparatuses has to be constantly checked through comparing it to the standard instrument and it is ideal to take multiple measurements and record the data sequentially, so gradual trends can be monitored and systematic and random errors will be minimized.

CONCLUSION

Students' understanding on the basic concepts of fluid mechanics improved when aided with manipulative apparatuses, where they can explore and perform actual hands-on experiences. This improved students' performance is attributed to the use of inexpensive demonstrations and experiments in gaining concrete knowledge on the concepts of fluid mechanics.

REFERENCES

Aina, K. J. (2013). Instructional materials and improvisation in physics class: Implications for teaching and learning. Computer, 2(20), 8.

C Nwike, M., & Catherine, O. (2013). Effects of use of instructional materials on students cognitive achievement in agricultural science. Journal of Educational and Social Research, 3(5), 103-107.

Cotton, J. (2014, December 15). Data: The importance of accuracy, integrity and real-time integration. Retrieved August 20, 2017, from Information Builders: http://www.informationbuilders.com/blog/james-cotton/19152

Courbin, L., Cristobal, G., Winckert, M., & Panizza, P. (2005). Design of a low cost Zimm–Crothers viscometer:

From theory to experiment. American journal of physics, 73(9), 851-855.

Creamer, R. E., Bellamy, P., Black, H. I., Cameron, C. M., Campbell, C. D., Chamberlain, P., & Stone, D. (2009). An inter-laboratory comparison of multi-enzyme and multiple substrate-induced respiration assays to assess method consistency in soil monitoring. Biology and fertility of soils, 45(6), 623-633.

DO 45, s. 2013 - Guidelines on the Provision of Science and Mathematics Equipment for Fiscal Year 2013. (2013, October 7). Retrieved August 20, 2017, from Department of Education: http://www.deped.gov.ph/orders/do-45-s-2013

Faculty Development and Instructional Design Center. (2005). Responsible Conduct in Data Management. Responsible Conduct of Research . DeKalb, Illinois, U.S.A.: Northern Illinois University.

Ironside, P. M. (2005). Teaching thinking and reaching the limits of memorization: Enacting new pedagogies. Journal of Nursing Education, 44, 441-448.

J L, "Experiential Learning (Kolb)," in Learning Theories, February 13, 2007, https://www.learning-theories.com/experiential-learningkolb.html

Kishore, L. (2009). Stepping into science in small schools: Together with tools, techniques and toys. In Proceedings: International Conference to Review Research in Science, Technology and Mathematics Education. Mumbai, India. January (pp. 5-9).

Kolb, D. A. (1984). Experience as the source of learning and development. Upper Saddle River: Prentice Hall.

Learn Implement Share. (2017, September 1). Procedural vs conceptual knowledge in mathematics education: Preparing to embrace a conceptual approach to teaching mathematics. Retrieved October 11, 2017, from Learn Implement Share: http://www.learnimplementshare.com/procedural-vs-conceptual-in-mathematics.html

Macfarlan, A. (2015, August 11). Consistent Data Collection and Recording. Retrieved August 21, 2017, from Better Evaluation: http://www.betterevaluation.org/en/evaluation- options/consistent_data_collection_and_record

McLeod, S. A. (2013). Kolb - Learning Styles. Retrieved from www.simplypsychology.org/learning-kolb.html

Microsoft. (2014, January 30). Data Consistency Primer. Retrieved October 4, 2017, from Microsoft: https://msdn.microsoft.com/en-us/library/dn589800.aspx

Mills, S. (2016). Conceptual Understanding: A Concept Analysis. The Qualitative Report, 21(3), 546-557. Retrieved from http://nsuworks.nova.edu/tqr/vol21/iss3/8

Oladejo, M. A., Olosunde, G. R., Ojebisi, A. O., & Isola, O. M. (2011). Instructional materials and students' academic achievement in physics: some policy implications. European Journal of Humanities and Social Sciences, 2(1).

Omari, T., & Chen, V. (2016, August 29). What is conceptual understanding? Retrieved August 21, 2017, from GETTING SMART: http://www.gettingsmart.com/2016/08/what-is-conceptual-understanding

Orleans, A. V. (2007). The condition of secondary school physics education in the Philippines: Recent developments and remaining challenges for substantive improvements. The Australian educational researcher, 34(1), 33-54.

Richards, C. D., Meng, M. F. S., Van Wie, B. J., Golter, P. B., & Richards, R. F. (2015). Implementation of Very Low-Cost Fluids Experiments to FacilitateTransfor-mation in Undergraduate Engineering Classes. age, 26, 1.

Rittle-Johnson, B., & Star, J. R. (2007). Does comparing solution methods facilitate conceptual and procedural knowledge? An experimental study on learning to solve equations. Journal of Educational Psychology, 99, 561-574.

Ross, A., & Wilson, V. (2012). The effects of representations, constructivist approaches, and engagement on middle school students' algebraic procedure and conceptual understanding. School Science and Mathematics, 12(2), 117-128.

Schwartz, J. (2008). A Distinction Between Conceptual Knowledge and Procedural Knowledge. Elementary Mathematics Pedagogical Content Knowledge: Powerful Ideas for Teachers, 7-8.

The Manila Times. (2014, May 28). Science education realities. Retrieved August 20, 2017, from The Manila Times: http://www.manilatimes.net/science-education-realities/100096/

Tubog, R. (2013). Resolution of Forces and Torques: Apparatus and Experiments (master's thesis). Siquijor State College, Siquijor, Philippines.

Visperas, E. (2011, June 30). Acute shortage of science labs in public schools seriously affects science education. Retrieved August 20, 2017, from Philstar Global: http://www.philstar.com/education-and-home/700852/acute-shortage- science-labs-public-schools-seriously-affects-science

Yale University. (2011, March 28). A Low-Cost Experiment to Teach Complex Concepts. Retrieved February 11, 2018, from Yale School of Engineering & Applied Science: https://seas.yale.edu/news-events/news/low-cost-experiment-teach-complex-concepts.

Yitbarek, S. (2012). Low-cost apparatus

from locally available materials for teaching-learning science. African Journal of Chemical Education, 2(1), 32-47.

SITE-SPECIFIC RESPONSE SPECTRA FOR SOUTH COTABATO, PHILIPPINES

Warda Panondi[1], Israel A. Baguhin[2]
[1]Mindanao State University-Main Campus, Marawi City
[2]University of Science and Technology of Southern Philippines

Volume 5, Issue No.1, January - December 2020

Vol.5 No.1 January - December 2020 ISSN: 2362 - 9096

JOURNAL OF HIGHER EDUCATION RESEARCH DISCIPLINES

JOURNAL

OF HIGHER EDUCATION RESEARCH DISCIPLINES

Northwestern Mindanao State College
of Science and Technology, Tangub City
Volume 5, Number 1
January - December 2020