ASSESSMENT OF INSTRUCTIONAL COMPETENCIES OF BACHELOR OF ELEMENTARY EDUCATION STUDENT INTERNS: BASIS FOR TRAINING ENHANCEMENT

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ABSTRACT Teachers are the key elements in maximizing the quality of education, improving schools, and successfully implementing curricula. This descriptive study aimed to determine the level of instructional competencies of the Bachelor of Elementary Education (BEEd) student interns of the Guimaras State College AY 2018-2019. Specifically, this study assessed the level of competencies of BEEd student interns and determined their strengths and weaknesses. The respondents of this study were the 42 cooperating teachers who rated the student interns. The main source of data was an adapted and modified questionnaire that contains a list of indicators for instructional competencies. The gathered data were encoded, organized, presented, analyzed, and interpretedusing Statistical Package for the Social Sciences software. Results revealed that student interns' instructional competencies, when categorized in terms of planning and preparation, teaching skills, management skills, evaluation skills, language proficiency, and intellectual skills were rated verysatisfactorily. In terms of planning and preparation skills, they showed very satisfactory skills in preparing the classroom for the day's lesson. In terms of teaching skills, student interns have the highest mean of using instructional aids and devices effectively. Moreover, on management skills, the highest-rated mean was found to show respect for consideration of students' opinions and suggestions. For evaluation skills, the student interns were rated fairly and objectively. Language Proficiency, interns possessed adequate vocabulary for teaching. Moreover, in terms of intellectual skills, they manifested a higher level of comprehension. The student interns' strengths were in evaluation and management skills, while their weaknesses were in teaching skills. It can bededuced that they possess the knowledge and skills required for teaching.

Keywords: Instructional, competency, assessment, Bachelor of Elementary Education

INTRODUCTION

One of the most important trainings that each education student must undergo is the Student Teaching Practicum/ Internship Program. This is part of the curriculum in both elementary and secondary education programs. Under this program, students are assigned to different participating schools for their practicum/internship assignments (Mazo, 2015). The major goal of the Student Teaching Program is to provide student teachers with a challenging, relevant, and rewarding experience, which will allow them to acquire professional competence (Olaer & Tancinco, 2016). Teacher Education Institutions(TEIs) in the Philippines are mandated to provide quality, relevant and goal-oriented experience to future teachers. Quality pre- service teacher education is the key factor in Philippine education (Commission on Higher Education, 2004). According to Olga (2012), teachers need a wide range of competencies in order to face the complex challenges of today's world. Teaching competency is an inherent element of an effective training process that contributes to the welfare of a particular country. The teaching skills and life-long learning competencies of professional teachers comprise the following: to perform complex pedagogical duties; to be well-spoken, in good mental and physical health, stable and tolerant; to have a propensity to work with the younger generation, well communicative and observational skills, tact, a vivid imagination, and leadership (Mandal,2018). This study was anchored on the instructional theory of Reigeluth (2013). According to him, an instructional theory offers explicit guidance on how to better help people learn and develop. It provides insights about what is likely to happen concerning different kinds of teaching and learning activities while helping indicate approaches for their evaluation. Instructional designers focus on how to best structure material and instructional behavior to facilitate learning.

Guimaras State College-College of Teacher Education is committed to teaching excellence. It provides trainings

for prospective teachers who have the calling for teaching. The College of Teacher Education may develop a training program based on the assessment of its student interns. Hence, the purpose of this study was to ensure, monitor, and assess the performance of its student interns. Moreover, the researchers believed that the findings of the study will contribute to the literature and help educators design a better practicum plan to develop and enhance the skills of student interns. Generally, this study determined student interns' instructional competencies as assessed by their cooperating or critic teachers in the secondary schools in the province of Guimaras where they were assigned for their student teaching for the second semester of the academic year 2018-2019. Specifically, this study sought answers to the following questions: (1) what is the level of instructional competencies of the Bachelor of Elementary Education student interns in terms of Planning and Preparation Skills, Teaching Skills, Management Skills, Evaluation skills, Language Proficiency, and Intellectual Skills, and (2) what are the strengths and weaknesses of student interns in their instructional competencies as assessed by their critics or cooperating teachers?

METHODOLOGY

This study used a descriptive research design. Descriptive research is a study designed to depict the participants accurately. More simply, descriptive research is all about describing people who take part in the study. This is often used as a pre- cursor to quantitative research designs. The general overview gives some valuable pointers as to what variables are worth testing quantitatively. The respondents of this study were the 42 critic teachers or cooperating teachers who observed and assessed the student interns assigned to them. The instrument used contains a list of indicators for instructional competencies adapted and modified from West Visayas State University-Janiuay Campus and CHED memorandum no. 20, series of 2013. Specifically, indicators include Planning and Preparation Skills, Teaching Skills, Evaluation Skills, Management Skills, Language Proficiency, and Intellectual Skills. The questionnaire was composed of statements that cooperating teachers had to answer on a five-point rating scale, which was coded and interpreted using the following scale: Outstanding (4.21–5.00), Very Satisfactory (3.41–4.20), Satisfactory (2.61–3.40, Unsatisfactory (1.81–2.60), Poor(1.00–1.80). The questionnaire was distributed after it was found valid and reliable and received securing communications from proper authorities to allow the conduct of this study. This study was conducted during the second semester of the Academic Year 2018-2019 in the elementary schools of the Schools Division of Guimaras where the student interns were assigned. The cooperating teachers were given one week to return the filled assessment questionnaire to the researchers. The identity of the cooperating teachers as assessors was treated confidentially. The statistical tools used in this study were the mean, standard deviation, and ranking. The gathered data from the collected questionnaires were encoded, organized, presented, analyzed, and interpreted using SPSS or Statistical Package for the Social Sciences

RESULTS AND DISCUSSION

L**evel of Instructional Competencies of Bachelor of Elementary Education (BEEd)**

Planning and Preparation

Table 1 presents the level of instructional competence of BEEd student interns in terms of planning and preparation. The student interns were rated very satisfactory in terms of planning and preparation, with the highest rating on preparing the classroom for the day's lesson (M=4.07). It was noted that students' interns see to it that the classroom was ready before teaching. However, they were short of providing learning situations that show balance among cognitive, affective, and psychomotor domains (M=3.69). This result was supported by the Ministry of Education (as cited in Koca, 2016) that teachers' competence in material planning and preparation is a requirement for the quality and efficiency of teaching. Through the materials/facilities used in the teaching environment, the content to be taught to the learner is concretized by appealing to more than one sense organ, the teaching process is enriched, and thus the learning process is fulfilled easily and rapidly.

Table 1. Level of Instructional Competence of Student Interns in Planning and Preparation Skills

Planning and Preparation Skills	Mean	Remarks
Clarify lesson requirements in advance when needed..	3.98	Very Satisfactory
Read, study and consistently spend time gathering information for his her teaching plan.	3.93	Very Satisfactory
Prepare well-organized daily plans.	3.93	Very Satisfactory
Analyze and identify specific learning tasks written in behavioral terms to attain within the time frame.	3.76	Very Satisfactory
Select appropriate learning experiences and activities reflecting creativity and imagination.	3.79	Very Satisfactory
Prepare a variety of teaching aids for specific purposes.	3.95	Very Satisfactory
Provide learning situations that show balance among cognitive, affective, and psychomotor domains	3.69	Very Satisfactory
Prepare the classroom for the day's lesson.	4.07	Very Satisfactory
Plan learning experiences/activities which provide maximum individual/ small group participation.	3.86	Very Satisfactory
Provide information about what students know and can do.	3.81	Very Satisfactory
Overall Mean	3.88	Very Satisfactory

Teaching Skills

Table 2 presents the level of instructional competence of BEEd student interns as to teaching skills. Results revealed that the teaching skills of student interns were rated very satisfactorily with an overall mean of 3.77. It is interesting to note that student interns have the highest mean on the item, "Use of instructional aids and devices effectively" (M=3.98). They also relate new ideas to previous and future lessons (M=3.95) and could present ideas/concepts clearly within the students' intellectual level (M=3.95). This means that BEEd student interns applied their knowledge and skills in handling their classes based on what they have learned and experienced. However, addressing students' multiple intelligences and grabbing every opportunity to use problem-solving processes and critical thinking were the skills that student interns were a little bit short of.

Table 2. Level of Instructional Competence of Student Interns in Teaching Skills

Teaching Skills	Mean	Remarks
Show evidence of mastery of the subject matter.	3.90	Very Satisfactory
Present ideas/concepts clearly within the student's intelllectual level.	3.95	Very Satisfactory
Use instructural aids and devices efffectively.	3.98	Very Satisfactory
Relate subject matter to actual experiences and inegrate witn the other fields.	3.83	Very Satisfactory
Go beyond textbook teaching.	3.69	Very Satisfactory
Relate new ideas to previous and future lessons.	3.95	Very Satisfactory
Use varied and interesting methods and strategies.	3.71	Very Satisfactory
Stimulate interest to learn more about the subject matter.	3.81	Very Satisfactory
Pose challenginf and thought-provoking questions.	3.57	Very Satisfactory
Restate difficult qustions to elicit desired response.	3.57	Very Satisfactory
Respond affectively to questions to elicit desired responses.	3.74	Very Satisfactory
Provide appropriate reinforcement (verbal-or non verbal)	3.81	Very Satisfactory
Provide opportunities to develop mental curiosity and the ability to ask questions.	3.74	Very Satisfactory
Grab every opportunity to use problem-solving processes and critical thinking.	3.55	Very Satisfactory
Provide activities to meet individual differences.	3.76	Very Satisfactory
Initiate activities to enhance creativity.	3.90	Very Satisfactory
Encourage the use of Filipino and English.	3.86	Very Satisfactory
Use handwriting style appropriate to grade/year level.	3.93	Very Satisfactory
Address individual differences of the students.	3.64	Very Satisfactory
Address multiple intelligences of the students.	3.55	Very Satisfactory
Overall Mean	3.77	Very Satisfactory

Management Skills

Table 3 revealed that the overall mean for management skills of student interns was rated very satisfactory with an overall mean of 3.93. This implies that generally, they have a foundation of knowledge on using different methodologies in teaching their students. Moreover, the highest rated mean was 4.12, stating that the student interns show respect for consideration of students' opinions and suggestions. This supports the idea of Lumpkin (as cited in Park & Hill, 2020) that when teachers model trust, fairness, honesty, respect, and responsibility, they could help students imbibe moral virtues.

Further, they also keep the classroom clean, comfortable, and conducive to learning as well as maximize class periods for learning activities (M=4.05). This result conforms to the principle that teachers should be competent in managing the learning environment to create an atmosphere conducive to learning (Corpuz, & Salandanan, 2007, as cited in Vecaldo, Andres, & Carag, 2017).

However, the lowest-rated mean of 3.74 states that the discipline of the classroom should be maintained. These, in turn, enable them to build learning inside the classroom and develop efficient classroom management. This connotes that the pre- service teachers are prepared and responsive in handling diverse learners.

Table 3. Level of Instructional Competence of BEEd Student Interns in Management Skills

Management Skills	Mean	Remarks
Start and end activities promptly.	4.02	Very Satisfactory
Maintain a responsive and disciplined classroom.	3.74	Very Satisfactory
Keep the classroom clean, comfortable, and conducive to learning.	4.05	Very Satisfactory
Handle classroom problems with fairness and understanding.	3.93	Very Satisfactory
Show respect for consideration of students' opinion and suggestions.	4.12	Very Satisfactory
Establish systematic routine activities for effective classroom management (passing of books, attendance, and greeting).	3.93	Very Satisfactory
Maximize class period for learning activities.	4.05	Very Satisfactory
Organized varied grouping of the class.	3.90	Very Satisfactory
Use appropriate management strategies.	3.79	Very Satisfactory
Conduct closer provision during class periods or other related school activities.	3.81	Very Satisfactory
Overall Mean	3.93	Very Satisfactory

Evaluation Skills

Table 4 showed the student interns' evaluation skills. Results revealed that the evaluation skills of the BEEd student interns got an overall mean of 3.93 described as very satisfactory. This means that they ensure to assess, monitor, and measure their students' learning progress to improve and develop their teaching skills. Moreover, the highest mean was found on the item, rate fairly and objectively with the mean of 4.10. Furthermore, the student interns rate fairly and objectively the grades, tests, assignments, projects, and other activities of their students. Furthermore, they keep records of all test results and accomplishments for grading purposes (M=4.02). This implies that student interns correctly track the student's performance through applying valid tests and measuring tools and as well as consistent documentation of the outcome of students' progress. This result is parallel to the idea that for the teachers to be able to draw the right feedback about the standing of the students and properly monitor their learning in the class, a teacher needs to employ precise measurement (Asaad & Hailaya, 2004). Thus, teachers need to be equipped with the principles underlying the development of good formative and summative tests. This indicates that the pre-service teachers are grounded on these assessment principles that are vital facets of the learning process.

Table 4. Instructional Competence of BEEd Student InternsinEvaluaton Skils

Evaluations Skills	Mean	Remarks
Give valid, reliable, and relevant tests.	3.95	Very Satisfactory
Correct test papers and return them, within a reasonable time.	3.98	Very Satisfactory
Keep records of all test results and accomplishments for grading purposes.	4.02	Very Satisfactory
Require appropriate assignments and projects.	3.93	Very Satisfactory
Rate fairly and objectively.	4.10	Very Satisfactory
Utilize evaluation results to improve instruction.	3.86	Very Satisfactory
Keep a record of the utilized test items.	4.02	Very Satisfactory
Use a variety of ways in measuring achievement.	3.79	Very Satisfactory
Provide evidence to tell how well the students have learned.	3.76	Very Satisfactory
Obtain feedback that helps him/her to make good decisions to guide instruction.	3.93	Very Satisfactory
Overall Mean	3.93	Very Satisfactory

Language Proficiency

Table 5 presents the assessment of student interns on language proficiency. Results show that the general rate of student interns in language proficiency was very satisfactory (M=3.87), with the highest rating on possessing adequate vocabulary for teaching (M=3.95). Moreover, they organized and express their ideas effectively in writing using grammatically correct English or Filipino (M=3.88). This means that the
interns have adequacy in using vocabulary for teaching. They could also express ideas in an organized manner with grammar consciousness. This implies that the student interns apply effective, appropriate communication techniques as a medium of instruction for the students.

However, they got a lower mean on speaking grammatically correct English or Filipino with proper intonation and appropriately to the subject's instructional objectives and ability (M=3.81).

Table 5. Instructional Competence of BEEd Student Interns in Language Proficiency

Language Proficiency	Mean	Remarks
Express ideas into writing using grammatically correct English or Filipino.	3.88	Very Satisfactory
Speak grammatically correct English or Filipino with proper intonation.	3.81	Very Satisfactory
Use English or Filipino appropriately to the subject's instructional objectives and students' or pupils' ability.	3.81	Very Satisfactory
Organize ideas effectively in English or Filipino.	3.88	Very Satisfactory
Possess adequate vocabulary for teaching.	3.95	Very Satisfactory
Overall Mean	3.87	Very Satisfactory

Intellectual Skills

Table 6 presents the evaluation results of instructional competence of student interns in terms of intellectual skills. Results revealed the overall assessment of intellectual skills was very satisfactory (M=3.81). This means that the student interns possess enough knowledge, understanding, and ideas in order to provide satisfactory teaching performance. Moreover, the highest mean was on manifesting a higher level of comprehension (M=3.88). Further, they apply different analytical modes in tracking problems methodically (M=3.83). The lowest rating was on manifesting critical, analytical, and creative thinking (M=3.74). This implies that although student interns have less difficulty in understanding but need a bit of improvement in their intellectual aspects.

According to Abdullina, Ortaev, Torybaeva, & Zhetibaev (2013), the fundamental basis for the development of teachers' competencies is their intellectual ability, which serves as the basis of their logical reasoning and determines how well they do all tasks.

Table 6. Instructional Competence of BEEd Student Interns in Intellectual Skills

Items	Mean	Remarks
Manifest a higher level of comprehension (textual, visual, etc.)	3.88	Very Satisfactory
Manifest proficiency and effectiveness in writing, speaking, and the use of new technologies.	3.81	Very Satisfactory
Manifest understanding of basic concepts across the domains of knowledge.	3.81	Very Satisfactory
Manifest critical, analytical, and creative thinking.	3.88	Very Satisfactory
Apply different analytical modes (quantitative and qualitative, artistic and scientific, textual and visual, experimental, observation, etc.) in tracking problems methodically.	3.95	Very Satisfactory
Overall Mean	3.87	Very Satisfactory

Strengths and Weaknesses in the Instructional Competencies of Bachelor of Elementary Education Student Interns

Table 7 shows that the six categories under instructional competence were rated equally as very satisfactory. It points out that regardless of the mean values of each category, the instructional competence of student interns was at a very satisfactory level. Each indicator of the instructional competencies was ranked based on its means. Among six categories, evaluation skills (M=3.93) and management skills (M=3.93) were on the top. This means that these skills were considered the strengths of the student interns. Finally, the sixth rank or the lowest-rated category is teaching skills (M=3.77). This implies that student interns are weak in teaching skills compared to other skills. This study conforms to the study of Ganal, et al. (2015) that student interns have difficulties and problems related to instructional skills, classroom management, and communications skills. Moreover, Cheng (2013) emphasized the importance of teaching practicum in teacher education. He reported that teaching practicum is a strategy that enables teacher educators to become competent in teaching.

The study of Ulla (2016) revealed that student interns struggle with classroom management and reinforcement of student participation, as some of the students did not listen and respect them during their actual classroom instruction. Therefore, they stated in the interview that this should be prioritized in order to gain a better understanding of how to manage classes.

Table 7. Instructional Competence of BEEd Student Interns

Indicators	Means	Remark	Rank
Planning and Preparation Skills	3.88	Very Satisfactory	3
Teaching Skills	3.77	Very Satisfactory	6
Evaluation Skills	3.93	Very Satisfactory	1.5
Management Skills	3.93	Very Satisfactory	1.5
Language Proficiency	3.87	Very Satisfactory	4
Intellectual Skills	3.81	Very Satisfactory	5

CONCLUSIONS

The student interns' instructional competencies, when categorized in terms of planning and preparation, teaching skills, management skills, evaluation skills, language proficiency, and intellectual skills were very satisfactory. The student interns' strengths were evaluation and management skills, while their weaknesses were teaching skills. The current educational system needs highly competent and dedicated teachers. Given the very satisfactory ratings on the instructional competence of BEEd student interns, it can be deduced that they possessed knowledge and skills that met the basic requirement for teaching. These assessment results reflect the quality of education and trainings they gained and how effectively they applied in their specific field. Furthermore, the results were also considered acceptable for the novice in the profession.

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SATISFACTION AND DIFFICULTY OF USING GOOGLE CLASSROOM AMONG BACHELOR OF SCIENCE IN CRIMINOLOGY

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ABSTRACT The recent addition of a virtual classroom is Google Classroom, a learning management system for schools that aims to simplify creating, distributing, and grading assignments. It was officially introduced as a feature of Google Apps for Education in August 2014. It provides a collaborative course space with a series of features similar to what one would find in a typical learning management system but with a more simplistic approach. This study was conducted to determine the level of satisfaction and difficulty of using Google Classroom. A descriptive research design was used in this study. Results revealed that majority of the respondents were male, around 64.1% of the population and 4th year (74.4%). Findings revealed that respondents were generally satisfied in the use of Google classroom. The BS Crim students consider the use of Google Classroom as an easier way in doing online research and like using google classroom to learn their lessons. However, they find difficulty in using Google Classroom as high speed internet is lacking and there is shortage of computer units during the submission of school work. There is a high level of satisfaction among criminology students in the use of google classroom despite that there is also a high level of difficulty. Accordingly, the decision-makers of the higher educational institutions should acknowledge the features of Google classrooms and build their infrastructure based on the result obtained in this study.

Keywords: *Satisfaction, Difficulty, Google Classroom*

INTRODUCTION

Technology serves as an accessible tool for students to explore their learning experience with their fingertips touching the android phone, computer screen, or moving a mouse to click. Computer programs help learners build a bridge to connect their reading text to the simulated real-world situation presented visually. It engages students in various activities and helps their learning beyond basic information (Gil-Garcia & Cinton, as cited in DiCicco, 2016). Technology can help students who learn differently reach their goals. The study of Martin and Parker (2014) states that many online courses are offered at the same time faculties are adopting synchronous virtual classrooms that enable them to interact with students in real-time. Many organizations have embraced it in their attempt to promote workforce learning while trying to cut travel time and costs associated with face-to-face instructor-led training (Xanthoula, 2015). The recent addition of a virtual classroom is Google Classroom, a learning management system for schools that aims to simplify creating, distributing, and grading assignments. It was officially introduced as a feature of Google Apps for Education in August 2014.

The Google Classroom is a feature that has recently been added to the suite of Google Apps for Education. It provides a collaborative course space with a series of features similar to what one would find in a typical Learning Management System (LMS) but with a more simplistic approach. By streamlining the interactions and communication processes students and instructors engage in, the focus can be placed where it belongs-on learning (Pennsylvania State University, 2014).

In reviewing research articles, few studies have been found regarding technology-based instruction, especially the particular Google Classroom program. One of the studies of Jakkaew and Hemrungrote in 2017, makes use of a unified theory of acceptance and use of technology 2 (UTAUT2) model to investigate the main factors that affect the implementation of Google Classroom in specific courses. The survey with 24 five-point Likert-scale questions was collected from students who enrolled in these courses. The study utilized 'The Google Form questionnaires' as a tool to measure the level of users' satisfaction and self-evaluation. Additionally, it makes use of the assessment in terms of grading. The main findings support the fact that Google classroom can improve the students' selfdirected learning (SDL) cognitive skills.

The Google Classroom is available as a tool for developing the teaching and learning process worldwide. A study that has been implemented in Bangladesh tries to investigate the importance of this e-learning tool for both students and faculty members. It focuses on certain factors that rely upon the poor engagement of students in Google classroom. The most important findings emphasize the fact that students prefer engagement in Google classroom, where the teachers have passive roles rather than being engaged in a class where the teachers have more active roles. However, the Google classroom suffers from certain limitations in the study conducted by Iftakhar (2016), "Google classroom: what works and how?" The results are gathered from a questionnaire that was developed to serve the same purpose. In this respect,

it has been stated that "The analysis of the results of the questionnaire indicates that this study can be effective in understanding and evaluating teachers' and learners' perceptive to ensure quality teaching and learning through Google classroom."

This study was anchored on the theory of the Technology Acceptance Model (TAM), which is considered the most influential and commonly employed theory for describing an individual's acceptance of information systems. It was adopted from the Theory of Reasoned Action (Ajzen and Fishbein, 1980) and originally proposed by Davis (1986), assumes that an individual's information systems acceptance is determined by two major variables:
Perceived Usefulness (PU) which refers to the degree to which a person believes that using a particular system would enhance his/her job performance and Perceived Ease of Use (PEOU) which refers to the degree to which a person believes that using a particular system would be free from efforts (Al-Maroof & Al-Emran, 2018).

Based on the available research studies, it has been observed that there was a limited number of research articles that examined the use of Google classroom acceptance among university students in general. The Guimaras State College has implemented the Google classroom in all its departments creating a need to investigate the satisfaction and difficulty of using the Google classroom in BS Criminology through an empirical study. Thus, the main objective of this study was to determine the level of satisfaction and difficulty of using Google Classroom among Criminology Students. Specifically, this study sought answers to the following questions: (1) what is the level of satisfaction of the students in the use of Google Classroom; (2) what is the level of difficulty of the students in using Google Classroom; (3) are there significant differences in the satisfaction level of students in the use of goggle classroom in terms of their age and year level; (4) are there significant differences in the difficulty level of students in the use of goggle classroom in terms of their age and year level, and (5) is there a significant relationship between students' level of satisfaction and difficulty in the use of Google Classroom?

METHODOLOGY

The descriptive research design was used to determine the level of satisfaction and difficulty of using Google classroom among the BS Criminology students. Total enumeration of the 2nd year, 3rd year, and 4th year BS Criminology students of the College of Criminal Justice Education were employed in the study. Specifically, this study used ten (10) questions to assess the level of satisfaction and difficulty of the students on the use of Google Classroom of the third-year Bachelor of Science in Criminology enrolled during the AY 2016-2017. The data needed in the study were gathered using a researcher-structured questionnaire which undergone validity and reliability with a value of 0.83. Composed of two parts, part 1 solicited the level of satisfaction with the use of Google Classroom in their subject and part 2 solicited the level of difficulty in using Google Classroom. The questionnaires were distributed to the respondents with accounts in Google classroom. The researchers explained the purpose of the study to the respondents and ensured that the data gathered were treated with utmost confidentiality and anonymity. The responses were tallied, tabulated, and analyzed using the Statistical Package for Social Sciences (SPSS) using the frequency count to determine the number of respondents who answered a particular statement in determining the level of satisfaction and difficulty of using Google Classroom, mean to find out the level of satisfaction and difficulty of the students where the respondents were taken as a whole group and when classified according to categories of variables, Product– Moment Correlation Coefficient (Pearson's r.) was used to determine the strength of correlation between the students' satisfaction and difficulty in the use of Google Classroom in learning the subject.

RESULTS AND DISCUSSION

Profile of the respondents. Data for Research Question 1 were analyzed via descriptive statistics. The following table displays the Demographic information of the respondents, such as sex and year level. The majority of the study respondents were male (64.1%) and 35.9% were female. This emphasizes that the male contributed more than the female in the study. Most of the respondents were in the 4th year 58 out of 78 or 74.4%. Sixteen or 20.5% of respondents were in the third year, and 4 or 5.1% were in the second year.

Table 1. Profile of the respondents

Particulars		Frequency	Percent
Sex	Male	50	64.1
	Female	28	35.9
Total		78	100.0
Year Level			
	2nd Year	4	5.1
	3rd Year	16	20.5
	4th Year	58	74.4
Total		78	100.0

Level of Satisfaction

The first objective of the study was to analyze the satisfaction of students in the use of Google Classroom at BS Criminology of the College of Criminal Justice Education. A Five-point Likert scale was employed to find out the level of satisfaction of the student and contained ten (10) questions. The results provided in Table 2 show that the highest level of student satisfaction was reported in item, "Google classroom made online research easier," which was the highest mean equal to 4.14 interpreted as high. The second was "Liked using Google Classroom to learn my lesson," with a mean of 4.13. Followed by "Google classroom helped me find the appropriate links needed," with a mean of 4.12. These findings suggest that BS Crim students was generally has a high level of satisfaction in the use of Google classroom.

This supports the findings of Shaharanee, Jamil, & Rodzi (2016) that students were satisfied with the use of google classroom, thus, it is effective as an active learning tool. According to the study of Mafa (2018), the Google classroom is the best teaching tool for learning and instruction among college learners. This is on account that google classroom gives a simple paperless web-based learning environment.

Table 2. Level of Satisfaction (N=78)

Items	Mean	Interpretation
Liked using Google Classroom to learn my lesson.	4.13	High
Google classroom was easy to use.	4.04	High
I liked doing unit rubrics and daily rubric goals on the classroom board compared to the old way of writing on paper.	4.00	High
I felt more comfortable interacting with my classmates and teacher.	4.08	High
Writing in Google Classroom was better than paper notes.	3.99	High
Google classroom made online research easier.	4.14	High
Google classroom helped me find the appropriate links needed.	4.12	
My grade increased because of Google Classroom.	4.00	High
Google classroom helped me become more aware of the social studies content.	4.08	High
I create notes, drafts, and maps to complete assignments.		
Total	4.00	High
	4.06	High

Level of Difficulty

Reflected in Table 3 are the findings on the different areas of difficulties in the implementation of the Google Classroom encountered by the respondents. The result shows a general mean of 3.98, interpreted as high level of difficulty. The lack of high-speed internet and shortage of computer units during the submission of work were found at the highest level of difficulty (M=4.05) that the students encountered while using Google Classroom. Additionally, the extra money to pay for an internet café if no available unit in the library (M=4.00) and lack of skills in the Web, Google Classroom, and search engine (M=3.96) were also determined. This could be attributed to the fact that the application was not a mandate of SUC and CHED as part of the subject Computer 101.

The results correlate to the findings of Shaharanee, et al. (2016) that students' poor internet connection poses a challenge in submitting their assignments on time and most of the students were not able to pay for any data bundle, thus affecting their class participation.

Table 3. Level of Difficulty (N=78)

Items	Mean	Interpretation
Lack of high speed internet.	4.05	High
Availability of smart phone to most students.	4.01	High
Lack of extra money to pay for internet café if no available unit in the library.	4.00	High
Lack of skills in the web, Google Classroom, and search engines.	3.96	High
Internet connection is not available college wide.	3.97	High
It takes more time to learn to use the application appropriately.	3.94	High
Difficulty in using link/web link to lesson websites.	3.92	High
Insufficient knowledge and skills for using the computer.	4.00	High
Lack of technical understanding in searching for the latest information.	3.92	High
Lack of computer unit during the submission of work.	4.05	High
Total	3.98	High

Significant Difference in the Student's Level of Satisfaction in the Use of Google Classroom

The data presents sufficient evidence that there were no significant differences in the level of satisfaction of students towards the use of Google Classroom when they were categorized according to sex with a p-value of .420. This means that sex does not affect the student assessment on their level of satisfaction in the use of Google Classroom and year level with the p-value of 0.289. There is no sufficient evidence to support a statistically significant difference in the students' level of satisfaction using Google Classroom when they were grouped as to year level.

Table 4. Difference in the student's level of satisfaction towards the use of Google Classroom

Variable	U-value	p-value	Interpretation
Sex	623.500	.420	Not significant
Year level	H-value 2.480	.289	Not significant
TOTAL	81		100

Significant Difference in the Student's Level of Difficulty towards the use of Google Classroom

In terms of the student level of difficulty, data present adequate evidence that there is no significant difference in the student level of difficulty towards the use of google classroom when they were categorized according to sex with a p-value of 0.493. This means that sex does not influence the level of difficulty of the students in the use of google classroom and year level with the p-value of 0.497. There is no adequate evidence to support a statistically significant difference between the students' level of difficulty using google classroom when they were grouped in terms of year level.

Table 5. Difference in the student's level of difficulty towards the use of GoogleClassroom

Variable	U-value	p-value	Interpretation
Sex	634.500 H-value	.493	Not significant
Year level	1.400	.497	Not significant
TOTAL	81		100

Significant Relationship between Students' Level of Satisfaction and Difficulty in the use of Google Classroom

There is a statistically significant relationship between the level of satisfaction and level of difficulty in the use of Google Classroom. This relationship indicates that despite the high level of difficulty, students still manifested a high level of satisfaction in the use of Google classroom. This also implies that the student has difficulty using the Google classroom because it was needed and required by the teacher and due to external factors which are beyond their control, but they were satisfied, generally Google classroom made online research easier among students and they were able to check their scores immediately. This result supports Locke's Goal Setting Theory which refers to the effects of setting goals on subsequent performance. Researcher Edwin Locke found that individuals who set specific, challenging goals performed better than those who set general, easy goals. This is based on Locke's proposed five basic principles of goal-setting: clarity, challenge, commitment, feedback, and task complexity.

Table 6. Correlation

	r-value	p-value	Interpretation
Satisfaction	*	.000	Significant
difficulty	.612**		100
TOTAL	. 81		

CONCLUSIONS

This study determines the level of satisfaction and difficulty of using Google classroom among Bachelor of Science in Criminology students. The BS Crim students consider the use of Google Classroom as an easier way in doing online research and like using google classroom to learn their lessons. However, they find difficulty in using Google Classroom as high speed internet is lacking and there is shortage of computer units during the submission of school work. The year level and sex do not affect the assessment on satisfaction and difficulty of using the Google Classroom among BS Criminology students. There is a high level of satisfaction among criminology students in the use of google classroom despite that there is a high level of difficulty among them in the use of google classroom. To implement this technology practically, the higher educational institutions should provide the students with training opportunities so that students' abilities to discover the comprehensive and effective features of Google classrooms will be more apparent and implemented widely by the end-users.

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STAKEHOLDERS' AWARENESS AND PARTICIPATION ON QUALITY ASSURANCE PROGRAM OF GUIMARAS STATE COLLEGE

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ABSTRACT This study aimed to determine the stakeholders' awareness and participation in the quality assurance program of Guimaras State College for the academic year 2019-2020. The descriptive design of the research was used with 489 respondents. A researcher-made questionnaire was utilized in gathering data. The statistical tools used were the frequency count, percent, mean, standard deviation, Mann-Whitney Test, Kruskal-Wallis Test, and Spearman's rho. This study revealed that as a whole, the stakeholders have a very high level of awareness and manifested a moderate extent of participation in the quality assurance program of Guimaras State College. There were no significant differences found in the stakeholders' level of awareness on quality assurance program of Guimaras State College when they were classified into age, sex, and civil status. However, significant differences were found when they were classified into the category of stakeholder and educational attainment. Furthermore, no significant difference in the stakeholders' extent of participation on quality assurance program when the respondents were classified according to age and with significant differences in the variables sex, civil status, category of stakeholder, and education attainment. There is a significant relationship between the stakeholders' level of awareness and the extent of participation in the quality assurance program of Guimaras State College.

Keywords: *Guimaras State College, Quality Assurance Program, Stakeholders, Awareness, Participation*

INTRODUCTION

As part of its mandate to promote quality tertiary education in the Philippines, Commission on Higher Education (CHED) supports the development of Higher Education Institutions (HEIs) into mature institutions by engaging them in the process of promoting a culture of quality. Premised on a shared understanding of quality, CHED encourages the institutional flexibility of HEIs in translating policies into programs and systems that lead to quality outcomes assessed and enhanced within their respective internal Quality Assurance (QA) systems. This takes into consideration that particular types of HEIs will respond fittingly to global and national challenges, play their part in the economic development of the country, and promote policies of equity and social inclusion. CHED aims to support HEIs in developing institutional systems that lead to quality outcomes, as demonstrated by students and graduates whose competencies meet internationally recognized standards and are relevant to employment; to support HEIs in developing a culture of quality, reflected in internal QA systems that will help them perform effectively and efficiently and meet their desired outcomes and performance targets; and to engage HEIs in addressing policy issues, especially those that address the need to improve quality assurance in higher education. The internal capacity of HEIs to translate policy into quality programs and quality results depends on the established internal QA system.

The starting point of QA is articulating the desired quality outcomes, set within the context of the HEI's Vision, Mission, and Goals (VMG). This is the foundation for the development of a proper learning environment (content, methodology, and resources for the delivery of programs and services), assessment tools
(performance indicators, instruments), and the systems and process that are responsible for quality outcomes as well as sustainable programs and initiatives. QA will then look at institutional performance in terms of the HEI's capacity to translate policy (in terms of VMGO) into quality programs and quality results (Primer on the Quality Assurance and Institutional Sustainability Assessment of HEIs).

Guimaras State College, in its quest for quality as it envisions to be the center of excellence in education and green technology generation, has submitted its programs to accreditation, ISO 9001:2015 Quality Management System certification, and CHED's Institutional Sustainability Assessment, where the office of Quality Assurance looks into the sustainability of all these mechanisms as the institution develops the culture of quality, sustainability in the aspect of man power's capability to the procedures to meet the quality standards to be attuned to CHED's change of paradigm from the existing parameters of quality to the Outcomes-Based approach (Sollano, 2016).

Stakeholders often provide the needed resources and have the ability to control the interaction and resource flows in the system. They also ultimately have a strong impact on an organization's survival. Therefore, the awareness and participation of stakeholders should be an important part of quality assurance programs/activities.

As to how aware stakeholders on the quality assurance program of the College and how participative they are in these programs the fact that they play vital roles in the achievement of the GSC's vision and mission is not scientific yet.

Thus, this study was conducted to determine the stakeholders' awareness and participation on quality assurance programs of Guimaras State College, Buenavista, Guimaras for the Academic Year 2019-2020. Specifically, it sought to answer the following questions: (1) what is the profile of the respondents as to age, sex, civil status, category of stakeholders, and educational attainment; (2) what are the stakeholders' level of awareness and extent of participation on quality assurance program of Guimaras State College as a whole and when classified according to age, sex, civil status, category of stakeholders, and educational attainment; (3) are there significant differences in the stakeholders' level of awareness and extent of participation on quality assurance program of Guimaras State College when classified according to age, sex, civil status, category of stakeholders, and educational attainment; and (4) is there a significant relationship

METHODOLOGY

The descriptive-correlational research design was used in the study. It finds answers to the questions of who, what, when, and how this type of research describes a situation or given the state of affairs in terms of specified aspects or factors. What may be described are characteristics of an individual as a group or physical environment or condition (David, 2002). The total respondents of the study were 489, composed of 21 administrators, 63 faculty, 18 staff, 153 alumni, 166 students, and 68 parents who were selected through purposive sampling using Slovin's formula. A researcher-made questionnaire with three parts was used in this study. Part I was on the profile of respondents. It consists of questions about their age, sex, civil status, category of stakeholder, and educational attainment. Part II was a checklist questionnaire that measured the level of awareness of stakeholders on the quality assurance program of Guimaras State College. Part III measured the extent of participation of stakeholders in the quality assurance program of Guimaras State College. The researcher explained the purpose of the study to the respondents and ensure that their personal information remained confidential. The data gathered were encoded, analyzed, and interpreted using the Statistical Package for the Social Sciences (SPSS). The statistical tools used were the frequency count, percent, mean, standard deviation, Mann-Whitney Test, Kruskal-Wallis Test, and Spearman's rho.

RESULTS AND DISCUSSION

Profile of the Respondents. Data in Table 1 shows that majority of the respondents were young with ages ranging from 18 years old to 45 years old. Moreover, most respondents were females, single, students, and have attained college level.

Table 1. Profile of the Respondents as to Age,Sex, Civil Status, Category of Stakeholder, and Educational Attainment

Categories	Frequency (F)	Percent (%)
Entire Group	489	100.0
Age		
Young (18 years old to 45 years old)	368	75.26
Old (46 years old and above)		
Sex Male	121	24.74
Female		
Civil Status Single	175	
Married	314	35.79
Widow/er	269	64.21
	205	55.01
Category of Stakeholder Alumni	15	41.92
Student		3.07
Parent		
Faculty	153	31.29
Staff	166	33.95
Administrator	68	13.91
	63	12.88
Educational Attainment Post	18	3.68
Graduate	21	4.29
College Graduate		
College Level		25.56
Vocational Courses	125	31.90
	156	32.92
High School	161	.41
Graduate	2	
High School Level		
Elementary Graduate	6	1.23
Elementary Level	22	4.50
	10	2.05
	7	1.43

Level of Awareness on Quality Assurance Program of Guimaras State College when Taken as a Whole

Table 2 shows the stakeholders' level of awareness on quality assurance whereas as a whole, with M=4.34 and SD 0.656, the stakeholders all have a very high level of awareness. Among the items, "GSC as institutionally accredited" had the highest mean (4.49) as it is the recent quality assurance accomplishment of the College. On the other hand, "GSC is accreditation, ISO, CHED through ISA standards complaint" had the lowest mean of 4.24, still described as a very high level. This implies that the stakeholders were aware of the functions and activities of the Quality Assurance Program.

Idrus (as cited in Shabbir, et al., 2014) stresses that even though developed and developing countries have vastly different economic and social conditions, it will be helpful to implement quality assurance procedures in developing countries' higher education institutions. In Pakistan, it was found out that there were several issues and problems stakeholders face to enhance quality assurance in higher education such as lack of professional development skills, lack of awareness regarding the recent research, lack of physical facilities, and the number of trained staff (Shabbir, et al., 2014). Moreover, the study of Munshi & Bhatti (2009) revealed that the key aspect of quality assurance is assessment, transparency, faculty credentials, time-on-task measures, systematic monitoring, selection and training, student support services, and academic accreditation/quality control.

Table 2. Stakeholders' Level of Awareness on Quality Assurance Program of Guimaras State College when Taken as a Whole

Items	Mean	SD	Description
Quality Assurance ensures that there are mechanisms, procedures, and processes in place where quality is delivered to clients	4.30	0.642	Very High Level
The quality assurance program of GSC includes accreditation, ISO, and CHED ISA	4.36	0.762	Very High Level
GSC has the official (Quality Assurance) that takes charge of the conduct of accreditation, ISO, and CHED ISA evaluation.	4.40	0.790	Very High Level
Quality Assurance system is an outcomes based approach	4.37	0.800	Very High Level
GSC is Institutionally Accredited	4.49	0.720	Very High Level
GSC is 9001:2015 Quality Management System certified	4.37	0.828	Very High Level
GSC is CHED ISA compliant	4.36	0.792	Very High Level
Quality Assurance program is a stakeholders' participatory endeavor	4.28	0.763	Very High Level
The internal quality assurance provides an opportunity for the development of a culture of quality in the institution	4.28	0.695	Very High Level
GSC is accreditation, ISO, CHED through ISA Standards compliant	4.24	0.784	Very High Level
Total	4.34	0.656	Very High Level

Scale: 4.21 – 5.00 (Very High Level), 3.41 – 4.20 (High Level), 2.61 – 3.40 (Moderate Level), 1.81 – 2.60 (Low Level), 1.00 – 1.80 (Very Low Level)

Data in Table 3 reveal that when the stakeholders were classified as to age (young M=4.32 and old M=4.41), sex (male M=4.41, female M=4.31), civil status (single m=4.38, married M=4.30 and widow/er M=4.25), they all have a very high level of awareness on Quality Assurance programs of GSC. For the category of stakeholders, the students, faculty, staff, and administrators all have a very high level of awareness on Quality Assurance Program of GSC with a mean of 4.40, 4.94, 4.47, and 4.45 respectively, while the alumni with M=4.09 and parents with M=4.15 are have a high level of awareness of the program. As to educational attainment, respondents with a post graduate degree, college level, and vocational courses all have a very high level of awareness on quality assurance programs with a mean of school graduate, high school level, elementary graduate and acquired elementary level education have a moderate level of awareness of the program with mean 4.07, 3.88, 4.01, 4.00, and 4.17, respectively.

Table 3. Stakeholders' Level of Awareness on Quality Assurance Program of Guimaras State College when Classified According to Variables

Items	Mean	SD	Description
Age			
Young (18 years old to 45 years old)	4.32	0.637	Very High level
Old (46 years old and above)	4.41	0.709	Very High Level
Sex			
Male	4.31	0.586	Very HighLevel
Female	4.38	0.690	Very High Level
Civil Status			
Single	4.30	0.548	Very High level
Married	4.25	0.754	Very High Level
Widow/er	4.09	0.940	Very High Level
Category			
Stakeholder	4.40	0.696	High Level
Alumni	4.15	0.555	Very High level
Student	4.94	0.797	High Level
Parent	4.47	0.134	Very High Level
Faculty		0.431	Very High Level
Staff			
Administrator	4.45	0.383	Very High Level
Educational Attainment			
Post Graduate	4.74	0.354	Very High Level
College Graduate	4.07	0.671	High Level
College Level	4.39	0.562	Very High Level
Vocational Courses	4.80	0.283	Very High Level
High School Graduate	3.88	1.338	High Level
High School Level	4.01	0.870	High Level
Elementary Graduate	4.00	0.888	High Level
Elementary Level	4.17	0.842	High Level

Table 4 shows that when the stakeholders were taken as a whole they have a moderate extent (M=3.23) of participation on Quality Assurance Program of Guimaras State College. Moreover, they have a great extent of participation on assemblies called by the administration (M=3.35), and quality assurance orientation activity (M=3.49). Also, they have moderate participation in providing assistance during the conduct of quality assurance activities of the college (M=3.34) and disseminating quality assurance status to the other stakeholders/people in the community. However, they have lower participation on curriculum review (M=2.99), extension program (M=3.11), and in the planning of GSC development (M=3.11).

Table 4. Stakeholders' Extent of Participation on Quality Assurance Program of Guimaras State College when Taken as a Whole

Items	Mean	SD	Description
Acted as facilitator during accreditation, ISO audit and CHED ISA evaluation	3.04	1.612	Moderate Extent
Served as an interviewer during validation of information during quality assurance mechanism evaluation	3.20	1.513	Moderate Extent
Participated in the extension programs of GSC	3.11	1.568	Moderate Extent
Attended assemblies called by the administration	3.53	1.408	Great Extent
Involved in research activities of the college	3.16	1.513	Moderate Extent
Joined in the curriculum review	2.99	1.533	Moderate Extent
Participated in the quality assurance orientation activity	3.49	1.431	Great Extent
Provided assistance during the conduct of quality assurance activities of the college Disseminated quality	3.34	1.456	Moderate Extent
assurance status to other stakeholders/ people in the community	3.27	1.357	Moderate Extent
Participated in the planning of GSC development	3.11	1.490	Moderate Extent
Total	3.23	1.309	Moderate Extent

Data in table 5 revealed that as to age, both young and old stakeholders have a moderate extent of participation in Quality Assurance programs with a mean of 3.21 and 3.25 respectively; for sex, males (M=3.50) have a great extent of participation while females (M=3.07) participated moderately; as to civil status, single (M=3.46) stakeholders have a great extent of participation while the married (M=2.91) and the widow/er (M=3.37) participated to a moderate extent; for the category of stakeholder, the administrators (M=4.34) participated to the very great extent, the students (M=3.91), faculty (M=3.99), staff
(M=3.50) have a great extent of participation, parents (M=2.67) to a moderate extent, while the alumni (M=2.23) participated to a low extent. As to educational attainment, stakeholders with Post Graduate degree (M=3.80), in College level (M=4.05), attained vocational courses (M=4.20) have a high extent of participation, the elementary graduate (M=2.70) participated moderately while the college graduate (M=2.12), high school graduate (M=2.50) in high school level (M=2.39) and elementary level (M=2.63) participated in a low extent.

Table 5. Stakeholders' Extent of Participation on Quality Assurance Program of Guimaras State College when Classified According to Variables

Items	Mean	SD	Description
Age	3.21	1.319	Moderate Extent
Young (18 years old to 45 years old)			
Old (46 years old and above)	3.25	1.285	Moderate Extent
Sex			
Male	3.50	1.292	Great Extent
Female	3.07	1.295	Moderate Extent
Civil Status			
Single	3.46	1.294	Great Extent
Married	2.91	1.269	Moderate Extent
Widow/er	3.37	1.295	Moderate Extent
Category of Stakeholder			
Alumni	2.23	0.810	Low extent
Student	3.91	1.207	Great Extent
Parent	2.67	1.206	Moderate Extent
Faculty	3.99	0.916	Great Extent
Staff	3.50	1.163	Great Extent
Adminstrator	4.34	0.711	Very Great Extent
Educational Attainment			
Post Graduate	3.80	0.991	Great Extent
College Graduate	2.12	0.991	Low extent
College Level	4.05	1.072	Great Extent
Vocational Courses	4.20	1.131	Great Extent
High School Graduate	2.5	1.367	vLow extent
High School Level	2.39	1.225	Low extent
Elementary Graduate	2.70	1.027	Moderate Extent
Elementary Level	2.63	1.093	Low extent

Table 6 shows no significant differences in the stakeholders' level of awareness on Quality Assurance program of Guimaras State College when they were classified according to age with p=0.056 and sex with p=0.273. The p-value for both variables is greater than 0.05. This implies that regardless of the age and sex of respondents their level of awareness does not vary.

Table 6. Difference in the Stakeholders' Level of Awareness on Quality Assurance Program of Guimaras State College when Classified According to Age and Sex

Categories	Mean Rank	Sum of Ranks	U	p - value	Description
Age					
Young (18 years old to 45 years old)	240.01	88803.00	2016	.056	Not Significant
Old (46 years old and above)	268.03	32968.00	8.00		Not Significant
Sex					
Male	256.38	44867.00	2618	.273	
Female	241.84	76904.00	3.00		

In Table 7, data showed no significant difference in the level of awareness on Quality Assurance program of GSC when they were classified according to civil status with p=0.901 but with significant differences when they were classified according to the category of stakeholder with p<0.000 and educational attainment with p<0.000. This implies that whether the respondents were single, married, or widowers their knowledge on Quality Assurance differs from each other.

Table 7. Difference in the Stakeholders' Level of Awareness on Quality Assurance Program of Guimaras State College when Classified According to Civil Status, Category of Stakeholder and Educational Attainment

Categories	Mean Rank	H	p-value	Description
Civil Status		.207	.901	Not Significant
Single	245.91			
Married	247.26			
Widow/er	262.90			
Category of Stakeholder				Not Significant
Alumni	190.77	111.540*	.000	
Student	253.74			
Parent	206.33			
Faculty	406.69			
Staff	260.31			

Administrator	248.57			
Educational Attainment				
Post Graduate	345.20	106.304*	.000	Not Significant
College Graduate	180.42			
College Level	250.70			
Vocational Courses	363.75			
High School Graduate	192.00			
High School Level	178.32			
Elementary Graduate	178.32			
Elementary Level	226.64			

Table 8 showed no significant difference in the extent of participation in Quality Assurance program of GSC when they were classified according to age with p=0.680 which is greater than 0.05 but with a significant difference when they were classified according to sex with p<0.000, which is less than 0.05.

Table 8. Difference in the Stakeholders' Extent of Participation on Quality Assurance Program of Guimaras State College when Classified According to Age and Sex

Categories	Mean Rank	Sum of Rank	U	P-value	Description
Age					
Young (18 years old to 45 years old)	240.01	88803.00	2016	.056	Not Significant
Old (46 years old and above)	268.03	32968.00	8.00		
Sex				.	
Male	256.38	44867.00	2618	273	Not siginificant
Female	241.84	76904.00	3.00		

Data in Table 9 revealed a significant difference in the stakeholders' extent of participation on Quality Assurance program of GSC when the respondents were classified according to civil status, category of stakeholder, and educational attainment with $p<0.00$ for all the indicated variables. This implies that the participation of the stakeholders varies to their civil status, categories, and educational attainment.

Table 9. Difference in the Stakeholders' Extent of Participation on Quality Assurance program of Guimaras State College when Classified According to Civil Status, Category of Stakeholder, and Educational Attainment

Categories	Mean Rank	H	p-value	Description
Civil Status				
Single	271.36	19.44*	.000	Significant
Married	213.94			
Widow/er	267.07			
Category of Stakeholder		175.71*	.000	Significant
Alumni	141.69			
Student	317.28			
Parent	187.57			
Faculty	333.66			
Staff	281.17			
Administrator	363.05			
Educational Attainment				
Post Graduate	311.93	210.45*	210.45*	Significant
College Graduate	128.79			
College Level	333.13			
Vocational Courses	370.50			
High School Graduate	370.50			
High School Level	168.25			
Elementary Graduate	154.70			
Elementary Level	193.90			
	180.50			

Table 10 shows a significant relationship between stakeholders' level of awareness and extent of participation in the quality assurance program with p<.000, which is less than .05. This means that the higher the awareness of the stakeholders on the quality assurance program, the higher their participation as well.

Table 10. Relationship in the Stakeholders' Level of Awareness and Extent of Participation in the Quality Assurance Program of Guimaras State College

Categories	level of awareness		
	rho	p-value	Description
Extend of participations	.508**	.508**	Significant

CONCLUSIONS

The stakeholders have a very high level of awareness of the Quality Assurance program of Guimaras State College, particularly as having an Institutionally Accredited institution. However, when classified according to age, sex, and civil status, the stakeholders manifested a similar level of awareness. Internal stakeholders like students, faculty, staff, and administrators show a higher level of awareness than external stakeholders like alumni and parents. As a whole, the stakeholders showed a moderate extent of participation in the quality assurance program of Guimaras State College. Moreover, when the level of awareness of the stakeholders on the quality assurance was high, their level of participation was also high. Thus, the Quality Assurance unit of Guimaras State College has to strengthen its dissemination of the status of quality of the college to consider all stakeholders, particularly the external ones to improve their level of participation.

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PASSENGERS' FEEDBACK ON THE DESIGN AND DEVELOPMENT OF WHARF TICKETING MANAGEMENT SYSTEM IN THE PROVINCE OF GUIMARAS, PHILIPPINES

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ABSTRACT The ticketing system provides tracking, monitoring, documentation, and support to all external and internal transactions. This study aimed to design, develop, and attain feedback on Wharf Ticketing Management System (WTMS) for the Island of Guimaras to assist the Province in gathering data on all passengers, vehicles, and cargoes entering and leaving the Island. The software has been developed through the inspiration of various prior arts, the Modified Waterfall Software Process Model, and packaged the various modules as one system software. In evaluating the effectiveness of the system, the study made use of the International Organization for Standardization 25010:2015 Software Quality Instrument and interpreted it using the descriptive research design to illustrate the feedback of the respondents. Results showed that the wharf ticketing management system was developed with a scheduling module that serve as a method of distributing the motorbanca to operate in a weekly scheme and ticketing module that applied discount privileges to qualified passengers. Moreover, effectiveness of the software in terms of functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability are all interpreted as "Very High." This implies that the ticket system during the evaluation, manual recording, retrieval, and processing of the data resulted in the efficient and effective delivery of services.

Keywords: *College of Science and Technology, GSC, Guimaras, Wharf, Ticketing System*

INTRODUCTION

The Island of Guimaras is accessible through the wharves situated in the municipality of Buenavista and Jordan. These two wharves serve as the busiest wharves operating daily on the Island. In its day-today operation, the records of the passengers are done in a manual process that leads to the following problems: first, the documentation of the passengers was done by advising passengers to write their information in the manifesto, which some passengers skip the process and proper documentation is not accurate leading to a tendency of overloading in the sea craft and second, calculation of the ticket cost requires time resulting in the delay of departure of motorbanca and proper discounting are not applied to the privileged passengers. This study on the Wharf Ticketing Management System was only limited to the design, development, and evaluation of the system used by the Province of Guimaras, particularly in the wharves on the Island. The conduct of this study was guided by the following set of activities such as developmental method and evaluation of the proposed features and functionalities of the developed WTMS system. The evaluation of the WTMS was conducted using the survey questionnaire using the ISO IEC 25010:2015 Evaluation Standard.

Generally, this study aimed to determine the passengers' feedback on the design and development of Wharf Ticketing Management System in the Guimaras Province. This study will assist the management in gathering the data of all the passengers, vehicles, and cargoes of merchandise entering and leaving the Province of Guimaras. As such, the following are the specific objectives of this study:

1.Attain feedback from the respondents on the design and development of the Wharf Ticketing Management System Integrated Modules.

2.Evaluate the Wharf Ticketing Management System in terms of functionality, efficiency, compatibility, usability, reliability, security, maintainability, and portability.

MATERIALS AND METHODS

The research methodology used in this study was the developmental evaluation of descriptive research. Likewise, an Iterative systems development model was used to design and develop the Wharf Management System.It applied developmetal research since this study
involves creating a database system that could be use by

by Wharf Management in processing passenger information and ticketing processes. Descriptive research was used for WTMS as evaluated by the end users and internal and external IT Experts using the ISO IEC 25010:2015 Evaluation Criteria. The evaluation was conducted using a survey wherein the evaluators or respondents rated the developed system utilizing a researchermodified questionnaire based on ISO/IEC 25010:2015. The Input, Process, Output, and Outcome approach was likewise used in developing the system. The iterative model's development stage included system design and coding development and was tested in repeated cycles. This approach was broken down from the broad application into smaller chunks. It has been recognized that the user interface design should be done iteratively since it is impossible to design a user interface that has no usability problem from the start. Even experts in interface design cannot perfect the user interface in just a single attempt. In that matter, the usability of the engineering lifecycle was built around the concept of iteration (Nielsen, 1993). Nielsen also emphasized that iterative development involves constant design refinement as a requisite in user testing. The study respondents were the enrolled passengers coming in and leaving from the Province of Guimaras, passing the two accessible wharves. After the minimum set of ISO IEC 25010: 2015 standards regarding eight (8) characteristics and 31 subcharacteristics were met by the developed Wharf Ticketing Management System, a researcher-made questionnaire composed of three (3) parts was used in determining the effectiveness of the developed system. Part I of the research instrument included the Profile of the Evaluators in terms of age, sex and course. Part II of the research instrument included the evaluation of incorporated modules. Part III included the effectiveness of the developed system based on the standardized questionnaire for evaluating developed systems as prescribed by ISO IEC 25010:2015. The standardized questionnaire was used to determine the system's effectiveness both by the IT experts and the users of the developed Wharf Ticketing Management System.

This Wharf Ticketing Management System was installed and implemented at Buenavista Wharf and Jordan Wharf. The developed system was installed in the main computer of the Wharf Office in the first week of November 2018. The Wharf Ticketing Management System was used as nuclear support information facility of the Wharf Offices. It was evaluated for its objective features and characteristics set by 60 respondent evaluators in the second week of November 2018.

This developmental evaluation study was guided by the following set of activities of developmental evaluation research methods wherein after the concepts had been framed, such notions were implemented using the interactive system of the Wharf Ticketing Management System. There was consultation classified as the planning stage in determining the ticketing process. The System Development Life Cycle (SDLC) models were used to manage this level of complexity .

Further, the designed software on the Province of Guimaras Wharf Ticketing Management System was evaluated in compliance with the Software Quality Standards of ISO IEC 25010:2015. The ISO IEC 25010:2015 is a software quality model that identifies eight (8) main quality characteristics: functionality, efficiency, compatibility, usability, reliability, security, maintainability, and portability of software programs created or used. The developed WTMS was tested and evaluated by 60 evaluators from both the internal and external where the internal evaluators included the end-users of the WTMS, both IT experts and non-expert passengers, and the other 30 external evaluators were all IT professionals or experts actively involved in information technology as College professors, IT teachers and local IT entrepreneurs in Iloilo City and Guimaras.

Areas or features of the developed system that fell below the compliance mean or rate were improved to comply with the standards set. A developed Wharf Ticketing Management that had met the ISO 25010 minimum set standards had further undergone evaluation by two (2) sets of evaluators, also known as respondents of this study. The instrument used in determining the effectiveness of the WTMS was evaluated by the local IT experts and the target users of the developed system. To achieve the objectives of this study, the researchers adopted the following instruments in the collection of data and for purposes of ease in the interpretation of the quality of the designed and developed system in meeting the customized needs of the endusers and clients and in compliance to the safety and quality characteristic prescribed by the ISO IEC 25010:2015 Evaluation Criteria for all developed communication and technology systems a five-point scale with 5 as the highest and 1 as the lowest was used in rating the effectiveness of the Wharf Ticketing Management System in terms of functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability.

The evaluation ratings were encoded using a Spreadsheet program to determine the result of the software evaluation. Mean was used in computing and measuring the acceptability of the software.

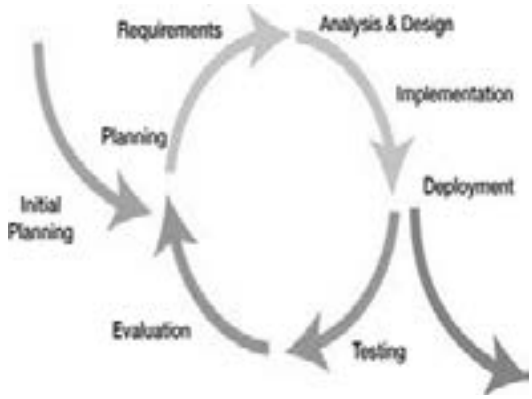
Mean was also used to determine the respondents' distribution in terms of their profile classification.

Software Life Cycle Model

The researchers used an Iterative Software Development Model. The Iterative starts with a small chunk of the system requirements and iteratively enhances until the full system is implemented. During each iteration, design modifications were made, and new functional capabilities were added. The basic idea behind this method was to develop a system through repeated cycles (iterative) and in smaller portions at a time (incremental).

Software Development Phases

The phases of software development using the Iterative Model are; requirements analysis, system design, system coding, system testing, and system implementation.



The requirements analysis phase was determined and analyzed based on the documents such as Manifesto by Philippine Coast Guard. The researcher inquired with the wharf management and the operator of the motorbanca, and passengers as to how the process of ticketing flows. Figure 2.0 presents the Data Flow of the Wharf Ticketing Management System.

Requirements Planning Phase. In this phase, the main task performed was gathering data that served as requirements to find out the customer's needs by analyzing the user requirements to be met by the system. Keen observance of the processes and follow-up questions also served as a tool to fully find their need. Planning for schedule and identification of risks involved, technical tasks, and resources needed were also done in this phase.

Analysis and Design Implementation. The second phase's main task was identifying data from the different available tickets and documentation records, and the system's design was developed that utilized the data. The researcher plans the logical operations and functions of the system. At the same time, the actual physical design implementation of the system, both database, and interface, followed by the designing of logical and data model like Data Flow Diagram as shown in Fig 2 Explosion of Data Flow Diagram then followed by the actual physical design of the system like system security, and modules supporting the different processes. The user interface design belongs to this task, and for database design, the researcher created different tables conforming to normalization standards to avoid anomalies and redundancy issues.Testing. In this phase, the researcher started the task of developing the database design that includes the physical and logical relationship of tables and where the coding of the system and the actual testing phase in which programs are developed and deployed and iteratively are updated and repeated the iterative model process. At this point of the task list, the researcher started to code the actual program aiming to give a solution for the identified problem of the study equipped with strict programming constraints to validate every data passed into the system. The programming language used in the development of the system was Visual C# and Structured Query Language (SQL) as the back end. The SQL was used to store, query, and manipulate data. It was used to manage data in a relational database which is also widely used nowadays by large organizations. After the development, the System was deployed in which the researcher installed the developed system as a beta version and used it. It is equipped with a logger to record every task done to easily identify the problems encountered and apply to debug to repair it. As a pre-requisite during the system development, a visual studio and MySql must be installed on a certain computer.

Evaluation Phase. In the fourth phase, the system developed was presented to the respondents who evaluated

it using the standardized McCall's Criteria for Quality Software. The evaluators were IT experts who used the ISO 25010:2015 Software Quality Model. This was conducted to randomly selected users of the WTMS.

Deployment Phase. In the last phase, where the smooth running and successful system developed was deployed to the client where support and help were given for them to use the system. The researcher stood by with the client to troubleshoot any unexpected problems that may occur while the system was deployed initially. The system could be implemented in a network environment where two (2) desktop computers were installed to use, the Wharf and another set of computers to a four-port switch. With this, principal offices such as the Philippine Coast Guard could access the wharf ticketing management system. The wharf ticketing management system should at least have the following hardware and software requirements to work, to wit:

Recommended hardware requirements
•Minimum Intel Pentium or equivalent/higher
•Minimum 1 Gigabit Hardisk
•With Network interface card Recommended software requirements
•Windows 7 Operating System
•MySQL opensource

RESULTS AND DISCUSSION

Passengers' Feedback on the Design and Development of Wharf Ticketing Management System Integrated Modules

Table 1 shows the result of the passenger's feedback on the design and development of Wharf Ticketing Management System Integrated Modules. The result shows that the first objective has a mean score of 4.65, interpreted as "Strongly Agree," which indicates that the respondents agreed after evaluating that the Wharf Ticketing Management System has a registration module that functions as an input collector of information for ticketing and other processes related to the ticketing management system. The second objective has a mean score of 4.75, with a verbal interpretation of "Strongly Agree." The result implies that the Wharf Ticketing Management System is developed with a Scheduling Module that serves as the method of distributing the motorbanca to operate in a weekly scheme. The third objective has a mean score of 4.73, still interpreted as "Strongly Agree." Respondents of the study agreed that the ticketing issuance could apply discount privileges to qualified passengers.

Table 1. Respondents' Feedback on the design and development of the Wharf Ticketing Management System Integrated Modules

Objective	Mean	Interpretation
To integrate a passenger registration module that will capture the data of the passengers for ticketing and other processes relating to the ticketing management system.	4.65	Strongly Agree
Integrate a scheduling module to ensure that all serviceable motorbanca are operating and distributed in a weekly scheme.	4.75	Strongly Agree
Develop a ticketing module that will apply the discount privileges to qualified passengers.	4.73	Strongly Agree
Total	4.71	Strongly Agree

Evaluation of the Wharf Ticketing Management System in terms of Functionality, Efficiency, Compatibility, Usability, Reliability, Security, Maintainability, and Portability

The result shown in Table 4 indicates that the Wharf Ticketing Management System has been evaluated using the ISO IEC 25010:2015 Evaluation Criteria and yielded an overall mean of 4.71, which can be interpreted as "Very High." Respondents of the study agreed that the system was effective during the conduct of the study as the system is functional, efficient, compatible, usable, reliable, secure, maintainable, and portable.

Table 2. Respondents' Feedback on the effectiveness and development of the Wharf Ticketing Management System

Particulars	Mean	Interpretation
Functional Suitability	4.64	Very High
Performance Efficiency	4.60	Very High
Compatibility	4.79	Very High
Usability	4.73	Very High
Reliability	4.77	Very High
Security	4.75	Very High
Maintability	4.70	Very High
Portability	4.69	Very High
Overall Mean	4.71	Very High

The findings of the two experts on several areas of the developed Wharf Ticketing Management System yielded a mean of 4.65, which has a verbal interpretation of "Very High." They confirm the enthusiasm behind the development of the said project. The two experts constantly agreed that the developed system was able to meet the users' requirements through the different functionalities.

Table 3. Evaluation of the Two Experts of the Developed Wharf Ticketing Management System

Objective	**Mean**	**Interpretation**
Evaluation of the Expert Evaluators using McCall's Software Model.	**4.65**	**Very High**

CONCLUSIONS

Users who evaluated the system agreed that the integration of the Passenger Registration Module served as the Input Collector for other processes of the ticketing system, as shown in the result. The system can distribute the motorbanca to operate in a weekly scheme through the scheduling module integrated into it as agreed by the respondents who evaluated the system. Further, the system can apply discount privileges to qualified passengers as agreed by the respondents who evaluated the system, as shown in the result. Wharf Ticketing Management System is evaluated in terms of functionality, efficiency, usability, reliability, security, maintainability, and portability through the ISO 25010:2015 Evaluation Criteria. The respondents evaluated the system as functional, efficient, compatible, usable, reliable, secure, maintainable, and portable. The system is functional, efficient, usable, reliable, secure, maintainable, and portable. The Province may adopt this developed software, Wharf Ticketing Management System, to assist and uplift its manual and weary processes of ticketing and documentation into modern and automated processes using the developed system, which is more effective and efficient.

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STUDENTS' PEDAGOGICAL AND CONTENT KNOWLEDGE (PCK) ON PROBLEM SOLVING HEURISTICS: BASIS FOR TRAINING ENHANCEMENT

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ABSTRACT This descriptive research aimed to determine the level of pedagogical and content knowledge (PCK) on problem-solving heuristics as the basis for training enhancement based on the least-learned competencies in problem-solving heuristics. The respondents were the preservice teachers who have taught mathematics subjects during their practice teaching school year 2018-2019. Purposive sampling was employed. The result showed that Bachelor of Secondary Education (BSEd) math majors were low while the Bachelor of Elementary Education (BEEd) were very low knowledge on problem-solving heuristics. The most common strategy used by the preservice teachers in solving problems was the algebraic approach or using an equation, making an organized list, and drawing a diagram. In terms of PCK, the BSEd has low pedagogical knowledge, high content knowledge, and average pedagogical knowledge, while the BEEd has low pedagogical knowledge, average content knowledge, and low pedagogical content knowledge on problemsolving heuristics. This simply means that the BSEd and BEEd's conceptual and procedural knowledge of problem-solving heuristics is at acceptable and below acceptable levels, respectively. As a whole, the pre-service teachers have low pedagogical content knowledge, average content knowledge, and low pedagogical content knowledge on problem-solving heuristics. This simply means that the BSEd and BEEd's conceptual and procedural knowledge on solving problems are acceptable and below acceptable levels, respectively. As a whole, the pre-service teachers have low pedagogical knowledge, average content knowledge, and low pedagogical content knowledge on problem-solving heuristics. Knowledge of content and pedagogy has a significant role during the teaching and learning process. Thus, the pre-service teachers must have a deep mathematical understanding and adequate conceptual and procedural knowledge of the different problem-solving heuristics so that they can transmit this to their students when they are in the field.

Keywords: *Pedagogical, content knowledge, problem-solving heuristics, Philippines*

INTRODUCTION

offering several courses under their umbrella. One of the departments in the College of Teacher Education (CTE), offers a Bachelor of Secondary Elementary major in Mathematics. The offering several courses under their umbrella. One of the departments in the College of Teacher Education (CTE), offers a Bachelor of Secondary Elementary major in Mathematics. The offering several courses under their umbrella. One of the departments in the College of Teacher Education (CTE), offers a Bachelor of Secondary Elementary major in Mathematics. The In the teaching of mathematics, the most common attitude of students is negative towards problem-solving. They find problemsolving difficult, as claimed by most mathematics teachers. This is maybe because they are used to doing computa-tions rather than using their analytical and critical thinking. They are more exposed to solving routine prob-lems using equations and algorithms for the solution. They are not familiar with other problem-solving strat-egies known as heuristics. The study of Pescuela (2006) showed that students who used heuristics in prob-lem-solving have a better performance than those who used an algebraic approach. those who used an algebraic approach.

Low performance of the students, especially in problem-solving is a resounding issue in basic education. The study of Junsay (2015) showed that students have low performance in problem solving and critical thinking. The study of Saylo (2013) also showed that the students have fairly developed problem solving and critical thinking skills. If the teacher has limited knowledge of the content, how could you expect them to teach effectively?

A teacher's knowledge of content and pedagogy has a significant role during the teaching and learning process. However, the fact that teachers have sufficient content knowledge on a subject does not mean they can teach this subject effectively (Kahan, Cooper, & Bethea, 2003). Teachers must also have adequate knowledge about how to teach a lesson, how to transmit it to their students and be aware of the level of the students. Thus, adequate content knowledge is not sufficient on its own for effective teaching (Tanisli & Kose, 2013). That's why many researchers have focused on how teachers teach in their field and reflect their content knowledge during the teaching and learning process, in addition to having adequate content knowledge.

When the capabilities of a good teacher are considered, content knowledge comes to the forefront (Appleton, 2003). The selection of effective learning activities depends on many teaching activities such as asking productive questions

and assessing the learning of the students, the teacher's knowledge of the subjects he/she will teach the students like a strong content knowledge. Kapyla, Heikkinen, & Asunta (2009) indicated that teachers who have inadequate content knowledge can transmit their deficient knowledge to their students and may fail to change the misconceptions or mistakes of the students who cannot use written sources critically.

Pre-service teachers need to be competent in their ability to teach mathematics subject to various classes of students. However, research has shown that becoming an effective mathematics teacher is a lengthy process. One way to advance pre-service teachers' knowledge of pedagogy and content on problem solving is through exposure to various problem solving strategies. When preparing pre-service teachers need to identify important content knowledge needed for teaching, how the knowledge needs to be understood, and how that knowledge should be learned in the classroom (Ball, 2000). The Philippines is the only country in Southeast Asia that has 10-year basic education (SEAMEO INNOTECH, 2012). Compared with other countries, the Philippines is almost far at the bottom in terms of educational development program implementation. Thus, there is a need to restructure our educational system. The Philippine education system shifted from 10 year to 12 year basic education by implementing the K to 12 curriculum under RA 10533, otherwise known as the Enhanced Basic Education Act of 2013. It started its implementation last school year 2012-2013. One of the problems encountered was the lack of teachers' training. The main purpose of this research is to determine the pre-service mathematics teachers' pedagogical and content knowledge (PCK) on problem solving heuristics. The result will determine the content standards to be included in the training workshop that could increase the level of their problem in solving heuristics knowledge on pedagogy and content of the subject in line with the K to 12 mathematics curriculum. Furthermore, this study also looks forward to the preparation of the preservice teachers that is parallel to the new curriculum. Specifically, this study was conductedto determine the level of problem solving heuristics of the pre-service mathematics teachers, and the level of Pedagogical and Content Knowledge (PCK) in problem solving heuristics of the pre-service teachers of Guimaras State College.

METHODOLOGY

This study was participated by the 13 pre-service teachers taking up Bachelor of Secondary Education major in Mathematics and Bachelor of Elementary Education both in Salvador and Mosqueda Campus enrolled in the College of Teacher Education AY 20182019. The researcher made problem solving heuristics test and
pedagogical and content knowledge (PCK) test. All instruments underwent face and content validation by a panel of experts in the field of mathematics. The mathematics achievement test was pilot tested to the first year BSEd major in Mathematics and underwent reliability testing. Problem solving heuristics test was composed of 10 items routine and nonroutine problem solving that measure the participant's content knowledge of problem solving heuristics. These problems involve solutions using heuristics such as drawing a diagram/picture, making organized lists, looking for a pattern, guessing and checking, using a model, working backward, writing an equation, using a formula, and acting it out. Pedagogical Content Knowledge (PCK) was designed to determine the pre-service teacher's pedagogical and content knowledge on problem solving heuristics. The final instrument was composed of 20 items multiple choice tests categorized into three domains: pedagogical knowledge, content knowledge, and pedagogical and content knowledge. The pedagogical and content knowledge test has a reliability coefficient of 0.834 through Kuder-Richardson (K20). The K20 is used to measure the internal consistency with to possible answers: right or wrong (Glen, 2016). The researcher utilized phase 1 of the Analysis, Design, Development, Implementation, and
Evaluation (ADDIE) model (McGriff, 2000) to design and develop the training module based on the least mastered PCK on problem solving heuristics. It has undergone analysis, design, development, implementation, and evaluation stages.
Phase1:Analysis.The researcher first cunducted an assessment and determined the level of pre-service teacher's PCK on problem solving heuristics.

Design. The level of preservice teacher's PCK on problem solving heuristics was the basis of designing a training module to enhance PCK on the pre-service teachers.

Development. A training module was developed to conduct a training workshop that was participated by the pre service teachers.

Phase 2: Implementation. The designed and developed training module was implemented and participated by the preservice teachers conducted by the experts in different fields.

RESULTS AND DISCUSSION

Level of Heuristics Knowledge

The level of heuristics knowledge of the pre-service teachers was analyzed using the mean score. Data in Table 1 shows that the level of pre-service teachers' heuristics knowledge was low as a whole. This indicates that the pre-service teachers do not have enough knowledge of the different problemsolving strategies. When classified according to course, the BSEd majors have low while the BEEd have very low knowledge on problem solving heuristics. This result confirms the study of Junsay (2016) and Saylo (2016) that students have low performance in problem solving.

The BSEd has a level higher than the BEEd, maybe because they have more math subjects than BEEd. But still, this result shows that they were not much exposed to different problem-solving heuristics. Out of 13 BSEd math majors, 7 or 53.85% have very low heuristics knowledge, while 6 0r 46.15% have low heuristics knowledge. On the other hand, all 11 or 100% BEEd have a very low heuristics knowledge.

The pre-service teachers' most common problem-solving strategies were algebraic approach or using equation, making an organized list and drawing a diagram. It shows that using equation is on the topmost maybe because most textbooks or reference books used this strategy.

Table 1. Level of Pre-Service Teachers' Heuristics Knowledge

Course	Mean	N	Std. Deviation	Description
BSED	12.31	13	2.95	Low
BEED	4.45	11	2.11	Very Low
Overall	8.71	14	4.74	Low

Level of Pedagogical Content Knowledge

The level of pedagogical content knowledge of problem heuristics was analyzed in terms of pedagogical knowledge, content knowledge, and pedagogical content knowledge. The pedagogical knowledge of problem solving heuristics of the BSEd preservice teachers was low. This implies that they have limited knowledge when it comes to how to carry out solutions to a problem. In terms of content knowledge, they have a high conceptual understanding of different strategies in problem-solving. Moreover, the BSEd pre-service mathematics teachers have an average pedagogical content knowledge on problem solving heuristics. This means that their conceptual and procedural knowledge on solving problems is at an acceptable level. The pedagogical knowledge on
problem solving heuristics of the BEEd preservice teachers was low. This means that they also have limited knowledge when it comes to how to solve a problem. In terms of content knowledge, they have average content knowledge on problem solving heuristics. This shows that they have an acceptable conceptual understanding of different strategies in problem solving. The BEEd pre-service teachers have a low pedagogical content knowledge on problemsolving heuristics. This means that their conceptual and procedural knowledge on solving problems is below an acceptable level.
The percentage distribution of the respondent was also analyzed. Out of 13 BSEd math majors, 1 or 7.69% have high Pedagogical and Content Knowledge, 11 or 84.62% have average Pedagogical and Content Knowledge, while 1 or 7.69% have low PCK. On the other hand, out of 11 BEEd, 1 or 9.09% have average Pedagogical and Content Knowledge while 10 or 90.91% have low Pedagogical and Content Knowledge.

Table 2. Level of Pre-service Teachers' Pedagogical and Content Knowledge

Course	Mean	Std. Deviation	Description
BSEd (n=13)			
Pedagogical Knowledge	4.00	1.00	Low
Content Knowledge	6.31	1.18	High
Pedagogical and Content Knowledge	5.46	1.20	Average
BEEd (n=11)			Low
Pedagogical Knowledge	2.64	0.92	Average
Content Knowledge	4.55		Low
Pedagogical and Content Knowledge	3.64	0.93 0.92	
Total			
Pedagogical Knowledge	3.38		Low
Content Knowledge	5.50		Average
Pedagogical and Content Knowledge	4.63	1.17 1.38 1.41	Average

CONCLUSIONS

Pre-service teachers need to be competent in their ability to teach mathematics subject to various classes of students, specifically on problem solving. Teachers who have inadequate content knowledge can transmit their deficient knowledge to their students and may fail to change the misconceptions or mistakes of the students and cannot use written sources critically (Kapyla, Heikkinen, & Asunta, 2009). Thus, the pre-service teachers must have deep mathematical understanding and adequate conceptual and procedural knowledge of the different problem-solving heuristics so that they can transmit this to their students when they are in the field.

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TRADITIONAL KNOWLEDGE SYSTEM ON FLORA AND FAUNA ON MANGROVE AREAS IN BUENAVISTA AND SAN LORENZO, GUIMARAS

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ABSTRACT The study aimed to document the traditional knowledge on mangrove areas of Buenavista and San Lorenzo, Province of Guimaras. Specifically, to determine and document flora and fauna of mangrove areas of the two municipalities (Buenavista and San Lorenzo) in the Province of Guimaras. Based on the result and findings of the study conducted, there were six (6) common mangrove or "bakhaw" species found in mangrove areas of the municipalities of Buenavista and San Lorenzo, namely: bongalon, pagatpat, bakhaw-babae, bakhaw-lalaki, bakhaw-bato, and apiapi. Community people living near the mangrove areas are conducting activities such as panghulip (replanting), panghampil (establishing rock barriers), and dapug (allowing the propagules to be rooted first, before planting). The "Bakhawan" or mangrove areas of Buenavista and San Lorenzo provided a natural environment of the following: bangi-bangi, dawat, halo-halo, suso, sihi, laway-
laway, and sisi. However, the decrease in the number of trees affects their population. It provided the fisherfolks and other people in the community an extra income because people are doing "panginhas" (catching fishes and crustaceans) during low tide. The researcher recommended that the maintenance and preservation of flora and fauna of the mangrove area should be a collaborative effort of the barangay officials, people's organizations and government agencies.

Keywords: *bakhaw, bakhawan, traditional knowledge system, mangrove, guimaras*

INTRODUCTION

Traditional Knowledge System (TKS) represents information, knowledge, skill, technology, and standard management practices defined through cultural systems. TKS evolved in a specific location within certain physical and sociocultural environments, where it reflects people's specific knowledge, understanding as well as observational and experimental information about their dwelling environments, along with skill and technology to design a lifestyle in that specific environmental context (Assam Science Technology and Environment Council, 2018). It includes oral narratives that reconnect human histories; astronomical observations and timekeeping methods; symbolic and decorative ways of communication; planting and harvesting strategies; hunting and gathering abilities; specialized knowledge of particular ecosystems; and the production of specialized tools and technology (Brucha, 2014). It is developed and passed on from generation to generation in the form of stories, songs, cultural values, traditional laws, local languages, rituals, healing arts, and agricultural practices for the collective good of the communities (Huntington, 2000; Brucha, 2014).
Today, it is widely acknowledged that TKS are time-tested, dynamic processes that can contribute greatly to the conservation and management of heritage. It can help conservation professionals better understand and safeguard the community's connection withheritage and overcome the artificial divides between tangible and intangible heritage and connect cultural heritage to the specific natural environment in which it is located (Wijesuriya & Court, 2020).

The use of TKS is now considered one of the cornerstones that can guarantee the survival of the economies of the developing world in the wake of scarce resources. Its use is essential in ensuring cultural resiliency in communities, developing the consciousness of each individual in protecting the environment for sustainable development and conceptualizing localized policies and intervention (Nkomwa, Joshua, Ngongondo, Monjerezi & Chipungu, 2014). Therefore, TKs must be gathered, organized and disseminated systematically as Western knowledge (Agrawal, 1995; Gonzalez, 1995 as cited by Ngulube, 2000). Recently, there have been no documented traditional knowledge systems on mangrove areas of Buenavista and San Lorenzo, Province of Guimaras. Therefore, this knowledge must be documented to revitalize the core of Guimaras culture and traditional knowledge systems.

Generally, the study aimed to document the traditional knowledge on mangrove areas of Buenavista and San Lorenzo, Province of Guimaras. Specifically, it aimed to determine and document flora and fauna of mangrove areas of the two municipalities (Buenavista and San Lorenzo) in the Province of Guimaras.

METHODOLOGY

Data and TK were obtained directly through interviews, communications, observations, taking images, recordings, etc., from the communities themselves. The identification of the respondents was done informally by discussing traditional knowledge systems with the barangay officials and asking them to identify people with traditional practices in their localities with reference to arable and habitable terrains. For indigenous people, the community or tribe chief, the elder, the shaman, an individual farmer, a community council, or whatever formal representative person or body was contacted to engage and transmit data and information in the form of TK. For this study, community people living nearest to the mangrove areas are the respondents. They were interviewed within the mangrove areas and others at their respective homes. The interview was conducted informally and was concentrated on the flora and fauna and traditional practices conducted in the mangrove areas.

RESULTS AND DISCUSSION

TKS on Mangrove Species and Practices

Mangrove forest is also known as the "rainforest of the sea." It grows well in tropical countries, including the Philippines. Mangroves are an important part of the coastal and marine ecosystem including the seagrass and coral reefs. Of the world's more than 70 mangrove species, around 46 species are known to occur in various parts of the country. Mangrove is a type of forest growing along tidal mudflats and along shallow coastal areas extending inland along rivers, streams and tributaries where the water is generally brackish. The mangrove ecosystem is dominated by mangrove trees as the primary producer interacting with associated aquatic fauna, social and physical factors of the coastal environment.

"Bongalon" (Avicennia marina) this species is widespread throughout its range. It is a fast-growing and fast regenerating, hardy species. It is threatened by the loss of mangrove habitat throughout its range, primarily due to extraction and coastal development. Since 1980, there has been an estimated 21% decline in mangrove areas within this species range. Mangrove species are more at risk from coastal development and extraction at the extremes of their distribution and are likely to be contracting in these areas more than in other areas. It is also likely that changes in climate due to global warming will further affect these parts of the range. Although there are overall range declines in many areas, they are not enough to reach any of the threatened category thresholds. This species is listed as Least Concern.

Figure 1. Bongalon (Avicennia marina).

"Pagatpat" (Sonneratia alba) is a fast-growing mangrove species with durable wood and many economic uses such as fuelwood, charcoal production, timber, post, fence, and others. It is a large tree reaching a height of more than 15 m and a diameter of over 40 cm. This species is suitable for planting in areas fronting the seas with deeper water and those affected by high tidal inundation and strong wave currents.

Figure 2. Pagatpat (Sonneratia alba)

"Bakha-babae" (Rhizophora mucronata) is a tree of the mangrove swamps growing up to 12 meters high, with numerous prop roots. Leaves are shining, oblong-elliptic, 8 to 16 centimeters long, 3.5 to 8 centimeters wide, and pointed at both ends. Cymes are axillary, 2.5 to 4 centimeters long, and bear 3 to 7 stalkless, white or cream-colored flowers. Fruit is ovoid, 3.5 to 5 centimeters long, pendulous, brown or olive colored, the persistent calyx-lobes are reflexed. Protruded radicle is green and cylindric, growing 20 to 40 centimeters long before falling off the tree. Seeds often germinate while on the tree and crop as young plants into the mud below.

"Bakhaw-lalaki" – (Rhizophora apiculata) is commonly found in most mangrove swamps in tropical Asia, from the delta of the Indus in Pakistan to Vietnam and Hainan. It occurs throughout the Malesian region and reaches southwards to the Tropic of Capricorn in Queensland, and eastwards as far as New Caledonia and Ponape (Micronesia).

"Bakhaw-bato" – **(Rhizophora stylosa)** is widespread in most of its range. This species is threatened by the loss of mangrove habitat throughout its range, primarily due to extraction and coastal development. There has been an estimated 20% decline in mangrove areas within this species range since 1980. Mangrove species are more at risk from coastal development and extraction at the extremes of their distribution, and are likely to be contracting in these areas more than in other areas. It is also likely that changes in climate due to global warming will further affect these parts of the range. Therefore there are overall range declines in many areas, but not enough to reach any of the threatened category thresholds. This species is listed as Least Concern

"Api-api" – (Avicennia officinalis) is a shrub or small tree reaching a height of 8 meters, often flowering when less than 1 meter high. Bark is light gray to brown, smooth but with small cracks. Leaves are leathery, opposite, dark green above and pale and hairy below, oblong-ovate to elliptic, 5 to 10 centimeters long, 2.5 to 5 centimeters broad, usually rounded at the apex and narrow at the base. Flowers are small, without individual stalks, appearing in small heads on stiff, angular and flowering stalks, occurring two together in the axils of the upper leaves, or several at the end of the branch. There are 3 to 7 flowers in each head. Corolla is orange-yellow, about 5 millimeters long, corolla tube being very short and cylindrical, with four lobes, 5 millimeters in length, hairy without and nearly smooth within. Calyx has five lobes, 2 to 8 millimeters long, hairy on the margins; and the lower part of the back is hairy and the rest, smooth. Fruit is an ovoid capsule, 2.5 to 4 centimeters long and contains a single seed which completely fills the capsule. Like other mangroves, the tree has numerous, leafless, blind, erect, conical root-suckers or air-roots, about 8 to 20 centimeters high.

Figure 4. Old Bongalon (Avicennia marina) and Pagatpat (Sonneratia alba) trees in Brgy. Tanag, Buenavista, Guimaras.

Figure 5. Newly planted mangrove (Bakhaw-babae Rhizophora mucronata) under matured trees. The practice is called "panghulip" which means, to replant.

Figure 6. Old mangroves growing in the coastal area of Brgy. Getulio, Buenavista.

Figure 7. Mangrove forest or "Lasang" , with various species of mangrove.

Figure 8. Garbage and other waste materials from nearby communities, taken by waves and were trapped by mangrove roots during low tide.

Figure 9. Newly planted rhizopora "Bakhaw" spp. in Brgy. Getulio, Buenavista. This is a part of the GSC Mangrove Rehabilitation Project fund by BFAR-6.

Figure 10. Old mangrove trees growing in the coastal areas of Brgy. Tanag, Buenavista.

Figure 11. "Hampil" or artificial rock barriers established by the fisher folks and other people in the community to protect the growing mangrove trees in Brgy. Suclaran, San Lorenzo.

Figure 12. Bakhaw babae (Rhizophora mucronata) producing "bunga"or propagules.

Figure 12. The result of the mangrovere habilitatio efforts,the"bakhawan" (mangrove area) of Brgy. Suclaran, San Lorenzo.

Figure 13. The set of propagules of Bakhaw- babae (Rhizophora mucronata) were allowed to be rooted first before planting using "dapug" method.

Figure 14. The "bakhawan" in Cabano River, San Lorenzo, Guimaras.

Mangroves protect the environment by protecting coastal areas and communities from storm surges, waves, tidal currents and typhoons. The crown and stem of mangroves serve as physical barriers. Their specialized roots trap and hold sediments and siltation from the uplands. Further, mangroves promote clear water, provide habitat for other living organisms such as fishes and crustaceans, and the growth of corals and sea grasses.

Mangroves are a good source of wood and timber and nipa shingles for housing materials, firewood and charcoal, and of poles for fish traps. Mangrove seeds and propagules can be harvested and sold. Fish, crustaceans and mollusks can also be harvested from mangroves. Aquaculture and commercial fisheries also depend on mangroves for juvenile and mature fish species. Last but not the least, mangroves are sources of tannin, alcohol and medicine (Mangrove Management Manual, CRM-DENR, 2000).

According to the informants, the existence of mangrove trees were observed since 1950's. Through the conducted researches on coastal forest, they found out that the mangroves have a lot of benefits for the people living in the coastal areas and to the environment. Mangroves provide habitat for the shells, crustaceans and fishes and provide them extra income because during low tide, people can do "panginhas", which is they can catch fish, crustacean, shell, etc. for market. Moreover, they believed that mangroves are best trees that protect seaside.

The maintenance and preservation activities were conducted by the fisher folks, barangay officials, workers, government agencies and other private organizations. As to the present, the provincial officials, barangay officials and other private organization are doing yearly plantation of mangroves. This activity was funded by BFAR and DENR in the selected coastal barangays. Despite continuous efforts of the community and peoples organizations on mangrove rehab and tree planting, some of the old mangrove trees were uprooted and died. According to informants, strong current of water due to the passage of fast crafts (travelling Iloilo-Bacolod-vice versa) was considered to be the main reason of erosion of underwater soils that greatly affects the anchorage of mangrove trees. If this problem will continue, old mangrove trees will be harmed and there will be no protection of some important living organisms in the area.

TKS on the Fauna of Mangrove Areas (Bakhawan)

Preserving coastal areas and mangroves is vital to people that live in coastal areas, providing them with fish and other seafood and offers protection from storms and tsunamis. Natural coastal environments and mangroves also play a vital role in absorbing carbon dioxide and combating climate change.

Mangroves are useful in many ways. Many commercial important fish and crustaceans spend part or all of their lives in mangroves, which also provide a home of many terrestrial animals. Some 250-acre sections of mangrove produce four tons of shrimp a year (Hayes, 2008).

"Bangi-bangi" or Fiddler crabs (Uca minar) are the little crabs found living in burrows near the water's edge. The large second claw of the male fiddler crab is known as a secondary sexual characteristic and is used to attract a mate during the breeding period (summer season) as well as to protect territories. The male crab will stand by the entrance to the burrow waving the larger claw in an effort to attract a female. Fiddler crabs are colonial, often living together in large clusters. Territorial fighting occurs between the males, and they will go to extremes to defend their burrows.

Fiddler crabs play a vital role in saltmarsh ecology because their feeding and burrowing helps keep marshes clean and helps them to grow. The many long, hollow burrows of a fiddler crab community help aerate the sediment of the marsh. (www.edc.uri.edu.,1998)

Figure 16. "Bangi-bangi" in the mangrove area of Lebas.

"Dawat" or Mud crabs (Scylla serrata) are large crabs with a smooth, broad carapace. They have 9 even sized teeth on each side of their eyes. Their two hind legs are flattened for swimming. In the most common form, the colour varies from very dark brown to mottled green. The other, generally smaller form has a deeper body and is reddish brown. Mudcrabs inhabit sheltered estuaries, the tidal reaches of some rivers, mud flats and mangrove forests, although females carrying eggs are present in deeper waters up to 50 kilometres offshore. These crabs favour a soft, muddy bottom, often below low tide level. Mating occurs when the female mud crab is in the soft-bodied condition following moulting. Female mud crabs in Australian populations migrate offshore to spawn and are rarely seen. 2 to 8 million eggs are produced in each spawning. Female crabs incubate the eggs for 2 to 4 weeks under their abdominal flap. Mud crabs mate in warmer months. Mature females release a 'pheromone' (chemical attractant) into the water to attract males. Once paired, the successful male climbs on top of the female, clasps her with his hind legs, picks her up and carries her around for up to four days. He releases her when she begins to moult. After she has shed her shell, he turns her upside down to mate. (Sea-ExAustralia,2017)

Figure 17. "Dawat" found in the "Bakhawan" (mangrove areas).

Figure 18. Mr. Nario Perez catching "dawat" under an old mangrove tree.

"Halo-halo" or Mudskipper (Periophthalmus barbarus or Periopthalmus koelreuteri) is a fish that belongs to the goby family. There are 34 species of mudskippers that can be found in the coastal waters of Pacific and Indian Ocean. Mudskipper lives in tropical and subtropical waters of various salinity. It inhabits tidal mudflats, estuaries and mangrove swamps. Even though habitat destruction threatens survival of mudskippers in the wild, their population is still large and stable. Mudskippers are not on the list of endangered species. Mudskipper can reach 2.75 to 9.75 inches in length and are usually olive-brown colored. Some species are covered with blue markings. It has frog-like, protruding eyes, torpedo-shaped body, muscular pectoral fins and two dorsal fins. Eyes of mudskipper move independently of each other. They can visualize objects above and below the surface of the water at the same time. Mudskipper is a carnivore (meat-eater). Its diet is based on insects, crustaceans, small fish and worms. Unlike other fish, mudskipper is able to survive on the solid ground during the low tide. It breathes using the gills, mucous membranes of the throat and mouth and dense capillary network in the skin. Mudskipper likes to rests on the roots, rocks and other objects located above the surface of the water. Too much time under the water can actually kill mudskipper. Mudskipper moves across the muddy surface using modified pectoral fins. Unlike the legs, pectoral fins move at the same time and pull the body forward. This type of movement is also known as "crutching" because pectoral fins resemble pair of crutches (Softschools.com., 2017).

Figure 19. "Halo-halo" or Mudskipper

"Suso" or Mangrove creeper snail (Clypeomorus pellucida) creeper snail is sometimes seen near and on mangrove tree roots or stuck to logs near the low water mark. About 2-3cm long. Shell thick with irregular ribbing and rather knobbly look. It is believed to eat microalgae (Wildsingapore, 2016).

Fig. 20. Suso or Mangrove creeper snail.

"Sihi" or Mangrove ear snail (Cassidula sp.) is sometimes seen in our back mangroves, on mangrove trees. The shell opening resembles an ear. Features: 2.5-4cm. Shell thick and oval, plain dark, underside with white or pale rim and mouth at the shell opening. It breathes air (instead of through gills like most other marine snails). The Banded mangrove ear snail (Cassidula nucleus) has bands on its shell. Other species of mangrove ear snails are not easy to tell apart in the field. It grazes on algae growing on mangrove trees and on the ground (Wildsingapore, 2016).

Fig. 21. "Sihi" at the trunk of "bakhaw" tree.

"Laway-laway" or Mangrove Periwinkle (Littoraria angulifera) The mangrove periwinkle has a small shell, about 3cm high and has 6 to 7 whorls with a pointed top. The shell is sturdy and is engraved with tiny helical lines with the seams being somewhat channelled. There is a middle channel at the lower side of the external lip. Its operculum (cover) is dull brown. The shell colour can be reddish, grey or somewhat with dark slanted markings.

On rare occasions it may be orange or yellow, and the inside is white (Abbot, 1968). Littoraria angulifera have fairly degenerate ctendia (gills) with a vascularised mantle epithelium, two features which support oxygen exchange in air (Hosien, 2015).

Figure 22. "Laway-laway" or Mangrove Periwinkle.

The **"Sisi" or mangrove oyster (Crassostrea gasar)** is a true oyster in the Ostreidae family. The mangrove oyster is found in tropical intertidal zones. It grows on the bark of the stilt sections of mangrove trees, which are exposed during low tides and covered during high tides. It can also be found on some other suitable intertidal substrates in its range. This oyster has evolved to survive exposed to the air during low tides (Boehs, 2011).

Figure 23. The "Sisi" grows on the roots of "Bakhaw".

in the coastal areas. The growth of mangrove trees act as permanent protection of the coastal areas of the barangay and provide habitat for other living organisms such as fishes and crustaceans. The fiddler and mud crabs help in cleaning surfaces under mangrove tree by digging a hole for them to hide. Mudskippers are carnivorous. They eat insects and worms that may harm the growing mangrove. The snails eat the dried leaves and growing algae in the roots and the stems of the trees.

CONCLUSIONS

There were six (6) common mangrove or "bakhaw" species found in mangrove areas of the municipalities of Buenavista and San Lorenzo, namely: bongalon, pagatpat, bakhaw-babae, bakhawlalaki, bakhaw-bato, and api-api. Community people living near the mangrove areas are conducting activities such as: panghulip (replanting), panghampil (establishing rock barriers), and dapug (allowing the propagules to be rooted first, before planting). The "Bakhawan" or mangrove areas of Buenavista and San Lorenzo, provided a natural environment of the following: bangi-bangi, dawat, halo-halo, suso, sihi, laway-laway, and sisi. But the decrease of the number of trees, affects their population. It provided the fisherfolks and other people in the community an extra income because during low tide, people are doing "panginhas" (catching fishes and crustaceans).

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KNOWLEDGE, ATTITUDE, AND PRACTICES (KAP) OF STAKEHOLDERS IN SITIO LUSAY AND AVE MARIA ISLET MARINE RESERVE AND SANCTUARY

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ABSTRACT This descriptive study was conducted to determine the Knowledge, Attitude and Practices (KAP) of the Coastal and Marine Eco-System Management Program (CMEMP) in Guimaras Province, particularly in Sitio Lusay and Ave Maria. It aimed to: (1) determine the knowledge of stakeholders on biodiversity, ecosystems, ocean and marine pollution, and climate change, attitude, and practices on marine protected area; and (2) identify the different communication channels that are being used/accessed by the stakeholders. The respondents of the study were the students/youth, household heads, local government unit key official, and teacher identified using simple random sampling. The statistical tools used were frequency, percentage distribution, and ranking. Results revealed that the respondents were aware and knowledgeable about biodiversity, ecosystems, ocean and marine pollution, and climate change. They have a positive attitude outlook on Marine Protected Area. Majority of them feel the need to protect the various ecosystems because it affects their source of livelihood. Unfortunately, most of them sometimes practice using tin cans and plastic waste but never practice throwing garbage anywhere, especially when they cannot see garbage bins nearby. Furthermore, they were likely to be informed concerning the country's biodiversity through television.

Keywords: *attitude, biodiversity, knowledge, practices, marine protected area*

INTRODUCTION

World Conservation Union defines marine reserves and santuaries as intertidal or subtidal environments, including flora and fauna features within their overlying waters that have been reserved and protected by law or other effective means (Horigue et al. 2012). Marine reserves and sanctuaries take on various forms and terminology around the world due to being at the interface of complex social and ecological linkages, but all have in common the characteristic of management interventions that are spatially organized. The governance protocols of marine protected areas also differ, consisting of temporary or permanent closures.

Many reserves will consist of "no-take" zones, including regulated buffer or nearby zones with extractive and non-extractive (Christie and White 2007). Marine reserves also consist of various implementation management regimes including top-down, bottom-up, co-management, centralized and private models. Marine protected area networks are also implemented in management planning and consist of a collection of individual MPAs or reserves operating cooperatively and synergistically at multiple levels designed to meet objectives that a single reserve could possibly not achieve. Marine Protected Area (MPA) establishment is increasingly recognized as one of the key strategies of coastal resource management (CRM) and is gaining worldwide recognition as an effective, low-cost habitat and fisheries management tool that can be organized and implemented directly by local communities (White et al. 2006). However, at present, there are too few MPAs and many of them are not effectively managed. For example, the Management Effectiveness Assessment Tool (MEAT) ranked the MPA established in Balcon Maravilla as a "Fair" condition. Under the National Fisheries Ordinance, 10% of municipal waters should be established as protected. This management plan is essential to guide stakeholders effectively in implementing the various sustainable interventions and conservation activities. The initial 5-year implementation period has the greatest effect on the success of the MPA.

To address the pressing concern on the protection and preservation of coastal and marine resources, the Philippines has now millions of hectares of established MPAs. Brgy. Lawi is the Municipal Marine Reserve and Sanctuary among these MPAs in Guimaras Island. The Municipal Marine Reserve in Barangay Lawi is geographically situated along

the coastline of Barangay Lawi, Jordan, facing the Panay Gulf. The total land area is eighty-four and nine thousand thirty-three ten-thousandths hectares (84.9033 ha.). Barangay Lawi had twelve sitios namely Igbantang, Bangcalalawag, Tubog, Lactad, Baybay, Manggacap, Matagsim, Burigot, Getuay, Proper, Lusay, and Punta Lawi. It has 30 hectares reserve area. The reserve is marked as a protection zone located around the Ave Maria Islet and along the coast of Sitio Getuay and Lusay. These areas are used as sustainable tourism zones designated along the beach areas of Sitio Burigot, Getuay and Lusay near Punta Lawi. The coastal waters along the southern end of Sitio Tubod extending into Sitio Lactad, Baybay and parts of Punta Lawi are designated as mariculture zones. There is a navigational zone located in Sitio Baybay that includes a wharf. Finally, the coastal areas along Sitio Tubog and Bangcalawag are for fish ponds.

In 2015, Barangay Lawi has 299 fisher folks, 39 fish vendors and 9 fish cage owners recognized under the Municipal Agriculture Office of Jordan. Structures in the area include privately owned fish cages and mangrove nurseries that can be found in Sta. Ana Bay. Within the boundaries of Sitio Baybay, there is a fish landing port, several coastal settlements and a basketball court that is often used as a multi-purpose area. There is also a pier used as a fish landing dock located within Sta. Ana Bay used by the fisherfolk of Barangay Lawi. During the summer season from March to July, tourist boats frequent the areas off the coast of Ave Maria, providing snorkeling and island hopping opportunities. The main sources of income are fishing, farming, and small business. Baseline information is necessary as this will be the basis for evaluating the program's impact in the community and this can be done through Knowledge, Attitudes, and Practices (KAP) Survey. Hence, this study was conducted to determine the Knowledge, Attitude, and Practices (KAP) of the stakeholders in Sitio Lusay, and Ave Maria, Jordan, Guimaras. Specifically, it aimed to: (1) determine the knowledge of stakeholders on biodiversity, ecosystems, ocean and marine pollution, and climate change; attitude, and practices on marine protected area and (2) identify the different communication channels that are being used/accessed by the stakeholders.

METHODOLOGY

This study made used of descriptive research design utilizing survey method. The respondents were the 33 student/youth, 2 household heads, local government unit key official, and teacher identified using simple random sampling method utilizing fishbowl technique. The permission to conduct the study from the municipal mayor, and punong barangay of Sitio Lusay and Ave Maria was secured by the Provincial Environment and Natural Resources Office (PENRO) prior to the fielding of enumerators. Strict compliance on ethical consideration was observed throughout the process. The data gathered were encoded, tabulated, and analyzed using Statistical Package for the Social Sciences (SPSS) software. The statistical tools used were frequency, percentage distribution, and ranking.

RESULTS AND DISCUSSION

Knowledge on Biodiversity

Marine Protected Areas (MPAs) are important in the preservation of marine species and biodiversity. Results revealed that almost all answered yes (51 or 98.1%), they know about biodiversity, while 1 or 1.1% answered no, they don't know about biodiversity. This implies that the educational campaigns of the different organizations, especially by the Provincial environmental office in the province, have already paid off relative to the responses made by the respondents on their level of knowledge on biodiversity. Biodiversity is essential for preserving ecological processes, such as fixing and recycling of nutrients, soil formation, circulation and cleansing of air and water, global life support (plants absorb CO2, give out O2), maintaining the water balance within ecosystems, watershed protection, maintaining stream and river flows throughout the year, erosion control and local flood reduction (Wilson, 1993).

The fifty-one (51) respondents who were knowledgeable about biodiversity identified its composition. They believed it was composed of: animals/microorganisms (51 or 98.1%), trees/plants/forest (50 or 96.2%), estuaries/ coastal areas (94.2%), rivers/lakes/streams (45 or 86.5%) and caves (37 or 71.2%).

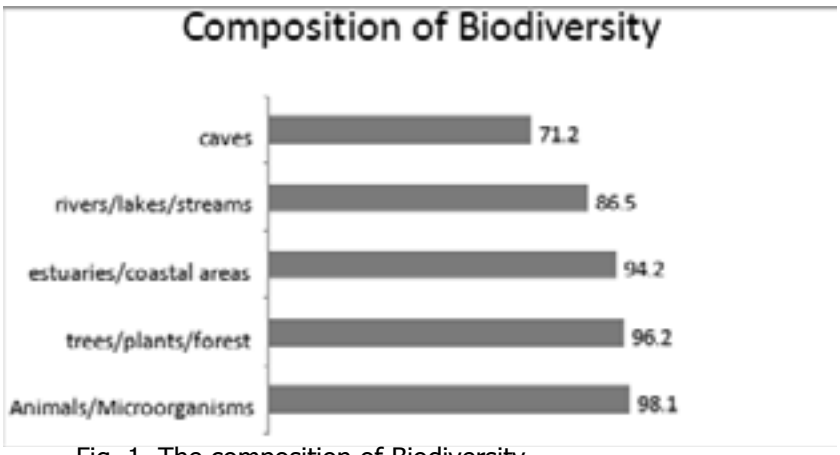


Fig. 1. The composition of Biodiversity.

On Ecosystems

Figure 2 shows the roles/importance of the coastal and marine and other ecosystems in the area. The result showed that all of the respondents agreed that it is the habitat of various species (52 or 100%) followed by it provides food, livelihood and medicinal benefits to the people (46 or

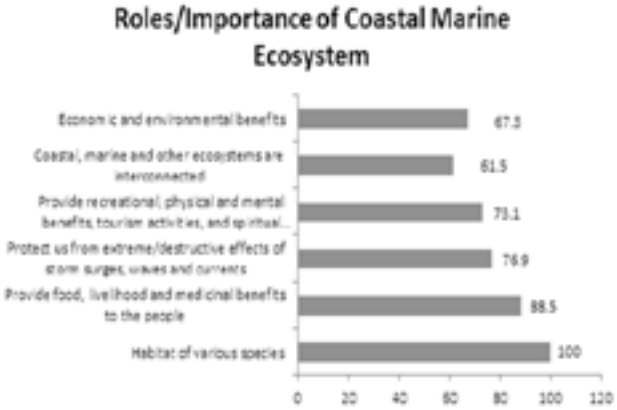


Fig. 2. Role of Coastal, Marine and other Ecosystem in the Area

Figure 3 shows the different ecosystems in the area. Results revealed that all of them identified mangrove forests and coral reefs (52 or 100%), followed by seagrass beds (50 or 96.2%), mudflat areas (43 or 82.7%), lowland forest (41 or 78.8%), rivers (41 or 78.8%) and caves (35 or 67.3%). Only a few identified salt marshes (25 or 48.1%) and lakes (13 or 25%). It can be gathered from these answers that the respondents are only aware of the marine ecosystem which they are so familiar with and they are not so familiar with other ecosystem considering their immediate surroundings are within the marine ecosystem.

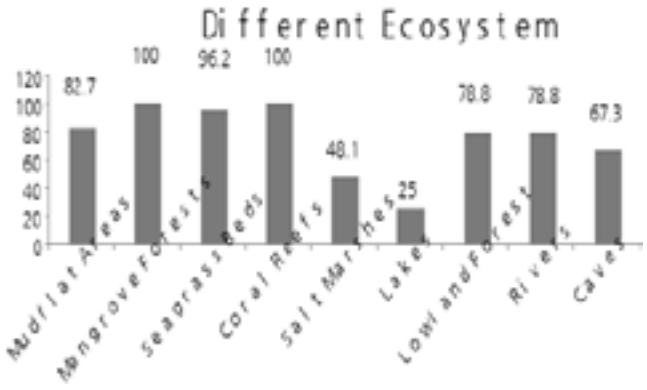


Fig. 3. Different Ecosystem in the Area

Mudflats. Table 1 shows the characteristics, importance, and factors/activities that affect mudflat areas. As to the characteristics of mudflat area, results showed that the majority of the respondents identified that it was deposited by tides or rivers (44 or 84.6%) and flooded due to change of tide level (27 or 51.9%), but few characterized mudflat as found in areas where tidal waves flow slowly (24 or 46.2%).

When respondents were asked if the conditions of the mudflat areas directly affect the source of food of various wildlife species, most of the respondents believed it affect the source of food with 46 (88.5%) responses, however, the six or (11.5%) were not aware.

They distinguished the importance of mudflats because it provides feeding and resting areas for water birds (44 or 84.6%), served as nursery areas for some fishes (41 or 78.8%) and rich in nutrients supporting a diversity of species.

Most of them believed that weather affects mudflats (38 or 73.1%), followed by the location of mudflats (32 or 61.5%) and tree planting (13 or 25%).

Table 1. Knowledge on Mudflat areas

Mudflats	F	%	Rank
Characteristics of Mudflat Area	44	84.6	1
Muds are deposited by tides or rivers			
Flooded due to change of tide level	27	51.9	2
Found in areas where tidal waves flow slowly	24	46.2	3
Does the condition of mudflat areas directly affect the source of food of various wildlife species?	48	88.5	
Yes	-	-	
No	6	11.5	
Not Aware			
Importance of Mudflat Areas			
Provide feeding and resting areas for water birds	44	84.6	1
Nursery areas for some fishes	41	78.8	2
Rich in nutrients supporting a diversity of species	24	46.2	3
Factors/Activities that affect Mudflat Areas			
Weather	38	73.1	1
Location of mudflats	32	61.5	2
Tree planting	13	25	3

Mangrove Forests. Table 2 shows the characteristics, importance and factors/activities that affect mangrove forests. All of the respondents believed that mangrove forests are composed of trees and shrubs in salty coastal areas, as well as it has a soft substrate (27 or 51.9%) and has prop roots, thick and waxy leaves (21 or 40.4%). Furthermore, when respondents were asked if the condition of mangrove forests affects the food source of various species like mollusks, crustaceans and fishes, almost all of them answered yes (51 or 98.1%) while the 1 or 1.9% was not aware.

Mangrove forests are important because it serves as a food source to many organisms (48 or 92.3%), natural breaker (42 or 80.8%) and it provides refuge to organisms (38 or 73.1%). Furthermore, illegal logging (49 or 94%), production of charcoal (45 or 86.5%) and fishing grounds (16 or 30.8%) are the factors/activities that can affect mangrove forests.

Table 2. Characteristics, Importance and factors/activities that can affect

Mangrove Forest	f	%	Rank
Characteristics of Mangrove Forest			
Composed of trees and shrubs in salty coastal areas	52	100	1
Has soft substrate	27	51.9	2
Prop roots, thick and waxy leaves	21	40.4	3
Does the condition of mangrove forests affect the source of food of various species like mollusks, crustaceans and fish?			
Yes	51	8.1	
No	-	-	
Not Aware	1	1.9	
Importance of Mangrove Forests			
Food source to many	48	92.3	1
organisms	42	80.8	2
Natural breakwater			3
Provide refuge to organisms	38	73.1	
Factors/Activities affect			
Mangrove Forests	49	94.2	1
Logging			
Production of charcoal	45	86.5	2
Fishing grounds	16	30.8	3

Seagrass. Table 3 shows the characteristics, importance and factors/activities that affect seagrass beds. All of the respondents believed that seagrass is entirely immersed in seawater. Also, 27 or 51.9% believed it grows in shallow marine and brackish waters, but only a few (21 or 40%) said that depth distribution is limited by light availability. Furthermore, all of them agreed that the condition of seagrass could directly affect fish productivity.

With regard to the importance of seagrass beds, majority of the respondent acknowledged that seagrass beds were important nursery ground for fish and other invertebrates (51 or 98.1%), followed by maintenance of biodiversity because it provides shelter and food for marine animals (45 or 86.5%) and only 42 or 80.8% replied that it stabilize coastlines and absorb nutrients from runoff. Further, an accident resulting in oil spills (52 or 100%), boatdocking (35 or 67.3%) and tree-planting (26 or 50%) were the factors/activities that can affect seagrass beds.

Table 3. Characteristics, Importance and Factors/activities that can affect Seagrass

Sea grass	f	%	Rank
Characteristics of Seagrass Beds			
Entirely immersed in seawater	52	100	1
Grow in shallow marine and brackish waters	27	51.9	2
Depth distribution limited by the availability of light	21	40.4	3
Does the condition of seagrass bed affect fish productivity?			
Yes	52	100	
No	-	-	
Not Aware	-	-	
Importance of our Seagrass bed			
Nursery grounds for fish and invertebrates	51	98.1	1
Maintenance of biodiversity: provide shelter and food for marine animals	45	86.5	2
Stabilize coastlines and absorb nutrients from runoff	42	80.8	3
Factors/Activities affect Seagrass BedsAccidents resulting to oil-spills			
Boat-docking	52	100	1
Tree-planting	35	67.3	2
	26	50	3

Coral Reefs. Table 4 shows the characteristics, importance, and factors/activities that can affect coral reefs. In terms of characteristics, the majority of them describes coral reefs as soft or hard organisms (43 or 92.3%), extensive and patchy (33 or 63.5%) and live, bleached or dead with algae (25 or 48.1%). Moreover, all of them agreed that the condition of coral reefs could affect fish production. In terms of the importance of coral reefs, all of them agreed that coral reefs served as habitat for fishes (52 or 100%), helps reduce strong wave action (46 or 88.5% and it can be the source of recreation (37 or 71.2%) for some people.

All of the respondents believed that global warming (52 or 100%) is one of the factors that can affect coral reefs. They also believed that poaching (35 or 67.3%) and dynamite fishing (26 or 50%) could affect the coral reefs.

Table 4. Characteristics, Importance and Factors/activities that affect Coral Reefs

Particulars	f	%	Rank
Characteristics of Coral Reefs			
Soft or hard	48	92.3	100
Extensive or patchy	33	63.5	67.3
Live, bleached or dead with algae	25	48.1	50
Does the condition of coral reefs			21.2
can affect fish production	52	100	
Yes			
No			
Importance of Coral reefs			
Habitat for fishes	52	100	1
Reduce strong wave action	46	88.5	2
Recreation	37	71.2	3
Factors/Activities affect Coral Reefs			
Global warming	52	100	1
Poaching	35	67.3	2
Dynamite fishing	26	50	3
Others	11	21.2	4

On Ocean and Marine Pollution

When respondents were asked if they have knowledge about ocean marine pollution, all of them answered yes. It implies that respondents are aware of the condition of the ocean and marine pollution and that the people are mainly the culprit why such conditions prevailed.

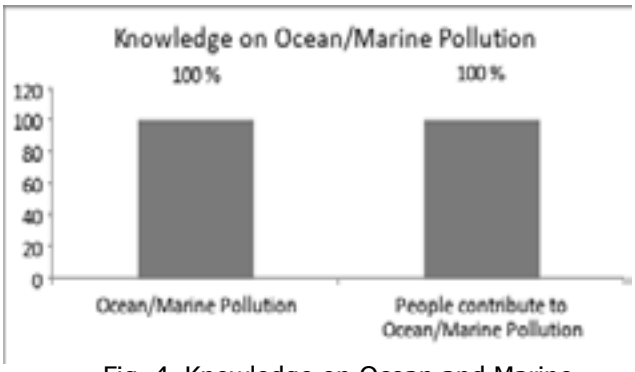


Fig. 4. Knowledge on Ocean and Marine Pollution

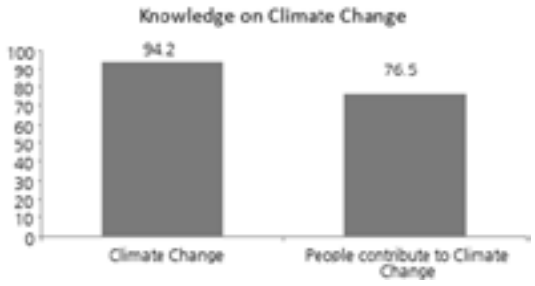
When respondents were asked about the sources of ocean/marine pollution, the result showed that plastics (52 or 100%) said to be the number one source of the ocean and marine pollution, followed by oil from cars, heavy machinery, industry, and other land-based sources (51 or 98.1%), pathogens from sewage and livestock (47 or 90.4%), runoff from sewage, deforestation, farming, and other land use, sedimentation due to erosion from mining, farming and coastal dredging (34 or 65.4%), toxins (32 or 61.5%), noised produced by supertankers, other large vessels and machinery (22 or 42.3%) and ballast water (19 or 36.5%)

Table 5. Sources of ocean/marine pollution

Ocean/Marine Pollution	f	%	Rank
Plastics	52	100	1
Oil from cars, heavy machinery, industry, other land-based sources	51	98.1	2
Pathogens from sewage and livestock	47	90.4	3
Runoff from sewage, deforestation, farming and other land use	41	78.8	4
Sedimentation due to erosion from mining, farming and coastal dredging	34	65.4	5
Toxins (heavy metals, Radioactive Substances, etc.)	32	61.5	6
Noise produced by supertankers, other large vessels and machinery	22	42.3	7
Ballast water	19	36.5	8
Others	1	1.9	9

Climate Change

In terms of the knowledge of respondents about climate change, 49 or 94.2% of respondents were aware of climate change but there are still 3 or 5.8% who were not aware of climate change. Forty (76.5%) respondents believed that people contribute to climate change.



When respondents were asked what climate change is, the majority of the respondents defined it as global warming (50 or 96.2%). Out of 52 respondents (47 or 90.4%) believed climate change is shifting weather patterns, (30 or 57.7%) said it is caused by humans, use of fossil fuels which release carbon dioxide and other greenhouse gases into the air, and (29 or 55.8%) said it is extreme weather conditions such as drought and flooding can compromise terrestrial crops and pressure on coastal and marine resources.

Table 6. Knowledge on Climate Change

Particulars	f	%	Rank
Global warming	50	96.2	1
Shifting weather patterns	47	90.4	2
Caused by humans, use of fossil fuels, which release carbon dioxide and other greenhouse gases into the air	30	57.7	3
Extreme weather conditions such as drought and flooding can compromise terrestrial crops and pressure on coastal and marine resources	29	55.8	4
Coastal areas are vulnerable to sea level rise, warming of the sea/ oceans, intensified weather disturbances	27	51.9	5
Low lying coastal communities being highly vulnerable to sea level rise	18	34.6	6
Ocean acidification	13	25	7

Attitude of the Stakeholders on Marine Protected Area

Table 9 shows the attitude of the respondents towards the Marine Protected Area. Results revealed that the respondents strongly agree that they will support and participate in local and national government efforts or programs in protecting biodiversity. Moreover, they always willing to help and felt the need to protect the various ecosystems because they believed that it was the Filipino obligation and responsibility.

However, they strongly disagree that they do not want to contribute to the country's biodiversity conservation activities because it was not their primary concern. Also, they also strongly disagree that they don't blame other people for the calamities that are happening because of their irresponsibility and they don't tend to disregard critical issues about our biodiversity because of the lack of knowledge.

Items	SRA	SLA	A	SLD	SRD
1. I feel the need to protect the various ecosystems because it affects my source of livelihood.	67.3	30.8	1.9	-	-
2. I am always willing to help to protect the various ecosystems by promoting sustainable use of biodiversity resources	67.3	28.8	3.8	-	-
3. It is every Filipino citizen's obligation and responsibility to protect our country's biodiversity and I have to find ways to do so starting in my area/community.	67.3	30.8	1.9	-	-
4. I want to show to my family, relatives and friends the ways to conserve and protect our biodiversity	63.5	34.6	1.9	-	-
5. I decided to be more conscious of my actions so that I could contribute to increase resilience against the adverse impacts of climate change.	55.8	26.9	17.3	-	-
6. I will support and participate in local and national government efforts/ programs in protecting our biodiversity.	75	13.5	11.5	-	-
7. I depend on people who are more knowledgeable in protecting our biodiversity because they know better.	50 1	15.45	19.2	15.4	-
8. I tend to disregard critical issues about our biodiversity because of lack of knowledge.	17.3	5.8	19.2	25	32.7
9. I do not want to contribute to the country's biodiversity conservation activities because it is not my primary concern.	-	21.2	-	63.5	15.4
10. I blame other people for floods and other calamities that are happening because of their irresponsible actions.	25	21.2	1.9	9.6	42.3

For the past six months, a total of 4 or 7.7% of respondents were involved regularly in activities led by the local government or DENR in the area, while 30 or 57.7% were only involved occasionally. However, 18 or 34.6% have never been involved. They are regularly and occasionally involved because it is their obligation (22 or 42.3%) and they want to learn updates and new information (12 or 23.1%).

Table 10. Involvement in LGU/DENR activities

Particulars	f	%
Involvement in activities in the past 6 months		
Regularly (once a month)	4	7.7
Occasionally (at least once in the past six months)	30	57.7
Never	18	34.6
Total	52	100
Reasons why regularly/occasionally attended/participated	22	64.7
It is my obligation	12	35.3
To learn updates and new information		
To clarify or ask question	-	-
Total	34	100

Practices on Marine Protected Area

Table 11 shows the practices towards marine protected area, result revealed that out of 52 respondents, 1.9% never practice, 80.8% sometimes practice and 17.3% always practice the use of tin cans, plastic straws, plastic bottles, and other plastic materials, 53.% never practice, 44.2% sometimes practice and 1.9% always practice throwing garbage such as plastic straws, candy wrappers, plastic bottles, etc. anywhere especially when they cannot see garbage bins nearby, 44.2% never practice, 44.2% sometimes practice and 11.5% always practice directly harvesting fish and other resources from the ocean for their family's daily sustenance, 100% never practice cutting of mangroves for charcoal production, 15.4% never practice, 53.8% sometimes practice and 30.8% always practice joining in tree planting activities and clean-up drives in their community and 23.1% never practice, 73.1% sometimes practice and 3.8% always practice taking photos of beautiful natural scenic spots and post them on social media to encourage their friends and relatives to visit and 50% never practice. In cases where illegal activities happen within the marine protected area, the majority of the area, respondents (26 or 50%) never report the activities to law enforcers, 16 or 30.8% always and 10 or 19.2% sometimes.

Table. 11. Practices of the Respondents in the Marine Protected Areas (MPAs)

Items	Never (%)	Sometimes (%)	Always(%)
1. Use tin cans, plastic straws, plastic bottles and other plastic materials.	1.9	80.8	17.3
2. Throwing garbage such as plastic straws, candy wrappers, plastic bottles, etc. anywhere	53.8	44.2	1.9
3. Directly harvest fish and other resources from the ocean for their family's daily sustenance.	44.2	44.2	11.5
4. Cutting of mangroves for charcoal production.	100		
5. Join tree planting activities and clean-up drives in my community.	15.4	53.8	30.8
6. Took photos of beautiful natural scenic spots and post them on social media to encourage friends and relatives to visit.	23.1	73.1	3.8
7. Report any illegal activities to enforcers	50	19.2	30.8

Table 12 shows the contribution to conservation and protection of biodiversity.
Results revealed that 51 or 98.1% contributed to the conservation and protection of biodiversity by practicing proper waste management, while 1 or 1.9% did not contribute. The result further shows that 44 or 84.6% were advocating and participating in activities involving conservation and protection of biodiversity while 8 or 15.4% were not advocating and participating.

Table 12. Contribution to conservation and protection of biodiversity

Particular	f	%
Contribute to the conservation and protection of biodiversity by practicing proper waste management		
Yes	51	98.1
No	1	1.9
Total	52	100
Advocating and participating in activities involvingconservation and protection of biodiversity		
Yes	44	84.6
No	8	15.4
Total	52	100

Communication Channel

Table 13 shows the media for communication that the respondents were likely to be informed of concerning the country's biodiversity. Results revealed that the respondent wanted to be informed through television (52 or 100%), key person's from DENR/LGU/Barangay Officials (48 or 92.3%), Radio (45 or 86.5%), law enforces (36 or 69.2%), Internet-social media (27 or 51.9%), newspaper (25 or 48.1%) and pamphlets, posters and brochures.

The respondents chose the top three most effective media for spreading awareness about the status of the country's biodiversity for which television (51 or 98.1%) on the top list followed by pamphlets, posters, and brochures (45 or 86.5%) and law enforces (27 or 51.9%). This correlates to the study of Shuva (2017) that respondents prefer to use television as the information media.

Table 13. Media for Communication

Particular	f	%	Rank
Television	52	100	1
Key persons from DENR/LGU/Barangay Officials	48	92.3	2
Radio	45	86.5	3
Law Enforces	36	69.2	4
Internet-social media (Facebook, Instagram, Twitter, Youtube, etc.)	27	51.9	5
Newspaper	25	48.1	6
Pamphlets, posters and brochures	17	32.7	7
Other	-	-	-
Top 3 most effective media to spread awareness	51	98.1	1
Television	45	86.5	2
Pamphlets, posters and brochures			
Law Enforces	27	51.9	3

CONCLUSIONS

The respondents were knowledgeable about biodiversity and marine protected area. The stakeholders identified the different ecosystems in the area, such as mangrove forests, coral reefs, seagrass beds, mudflat areas, and lowland forests. Furthermore, they were aware that coral reefs and seagrass affect fish productivity, wherein mudflat areas and mangrove forests affect the source of food of various wildlife species. They have a positive attitude towards coastal and marine ecosystems, especially on how to protect and take care of their community's natural resources. Moreover, they wanted to take information about MPA and biodiversity through television and key persons from DENR/LGU/ Barangay Officials. The three most effective media for spreading awareness about the status of the country's biodiversity are television, pamphlets, posters and brochures and law enforcers. The knowledge, attitude, and practices of the stakeholders on the ocean and marine will help them thrive and survive in the changing world.

***

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PHILIPPINE EARTHQUAKE FROM 1980-2013: A FRACTAL ANALYSIS

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ABSTRACT This study aimed to determine the Philippine earthquake from 1980-2013. This study aimed to determine, identify, locate, and map the different earthquake-prone areas in the Philippines using fractal analysis. This study was conducted at Guimaras State College-Salvador Campus. All the gathered data were analyzed using the FrakOut Software and Statistical Package for Social Sciences for windows based on the information obtained from the internet through data mining. Results shows that from 2000 to 2013 the faults located in the Philippines become more active. The multi-fractal dimensions implies at least two operant fractal dimensions: one operating at a lower scale (from 0 to 0.10) and another at higher scales (higher than the scale of 0.10). Moreover, the spatial analysis revealed that there were 168 earthquakes occurred from the period of 1980-1999. Mostly, in the eastern part of the Philippine Archipelago. In the period of 2000-2013, 151 earthquakes occurred showing more scattered and disarrayed lighter lines in the map. Fractal analysis of the earthquakes in the Philippines from 1980-2013 revealed that there was a tremendous escalation of earthquake incidences inside the places represented by the vertices of the triangles: Southeastern Mindanao, Northernmost part of Luzon, Eastern Samar, Romblon and Western part of Mindanao. It was noted that magnitude of an earthquake and its intensity was directly proportional to the damages caused by it and the depth of an earthquake has no significant relationship to the amount of damage. Further, the strongest earthquakes was recorded in Luzon last July 16, 1990 with the magnitude of 7.8 and intensity of X+.

Keywords: *earthquake, fractal, Philippines*

INTRODUCTION

The ground sometimes trembles when a heavy truck passes by. However, major earthquakes that make the ground shudder violently are set off by the movement of tectonic plates – the giant slabs of rock that make up the Earth's surface. Tectonic plates are moving all the time, radiating minor tremors as they grind past each other. Thus the pressure builds up until they suddenly lurch on again, sending vibrations, called shock waves, in all directions and creating major earthquakes that can bring down mountains and destroy cities (Grolier, 2004).

The Philippines is one of the countries that is located at the Pacific Ring of Fire. As we all know, violent volcanic eruptions, earthquakes, and tsunamis occurred here. Moreover, due to the presence of the Surigao Trench, the Philippines is vulnerable to earthquakes. Fault lines are almost located all over the Philippines and anent to this, frequent earthquakes strike the said archipelago, thus producing damage from a minimal to a maximum amount. The frequent earthquakes across the country are alarming and require a closer look into the phenomenon in order to inform and educate the Filipino people. In the year 1990, the strongest earthquake in the history of the Philippines hit the said country. It killed an estimated number of 1,621 people and causing damages worth P15 billion (De la Cruz, 2014).

Just where and when the next earthquake would occur on the archipelago are questions of immediate concern both for disaster- preparedness and national awareness concerns. The usual model in stochastic processes which is used to analyze the "when" question is the Poisson model (Ross, 1987), where the occurrence of the earthquake is assumed

to be Poisson distributed while the inter-earthquake times obey the exponential distribution. In such models, interest lies in the mean and variance of inter-event times. However, the model is based on a very restrictive assumption that the arrivals obey a specific Poisson model.

Along with this concern, other authors have proposed entirely different approaches to the problem. Telesca et al. (2004) and Relatorres et al. (2013) hinted on the use of fractal analysis in the case of seismic data (inter-event or inter-earthquake times) gathered from three (3) locations in Italy. Investigating the patterns of seismic sequences revealed evidence of time-scaling features. This was shown in the fractal analysis of the 1986-2001 seismicity of three different seismic zones in Italy. Describing the sequence of earthquakes by means of the series of the inter-event times, power-law behavior has been found applying Hurt analysis and detrended fluctuation analysis (DFA), with consistent values for the scaling exponents. The multifractal analysis has clearly evidenced the difference between the earthquake sequences. The Legendre multifractal spectrum parameters (Maximum A0'assymetry B and width W), singularity spectrum, have been used to measure the complexity of seismicity.

In this paper, the researchers used a simpler version of the Legendre multifractal spectrum as proposed by Padua et al. (2012). This same version was used by Padua and colleagues (2013) in the analysis of earthquake data for the Philippines. Meanwhile, the "where" question is approached through Geometric Fractals. Fractal geometry, the general impetus for fractal analysis, was introduced by Benoit Mandelbrot (1967) in his book: Fractals and Geometry of Nature. Mandelbrot posited that while classical geometry or Euclidean geometry focused on smooth, continuous and regular objects, nature is a strong motivation for developing that would describe its inherent ruggedness and irregularity. Crucial to this modeling is the notion of a dimension viz., that it is possible to construct real geometric objects whose dimensions are fractional rather integral. Fractal dimensions (λ) represent the ruggedness of an object: the higher they are, the rougher the objects are (Barera et al., 2013).

This study examined, determined, identified and located the different earthquake-prone areas in the Philippines using Fractal Analysis. As this study ascended to completion, the researchers were able to locate areas that are prone to earthquakes, thus government officials as well as the citizens would be prepared and would take precautionary measures to lessen the effect and the damages of the earthquake. It will also enable them to be prepared on when and where the earthquake would strike. It could also help us assess why a frequent earthquake occurs in a particular place.

Statement of the Problem

This study aimed to determine, identify, locate and map the different earthquake-prone areas in the Philippines using fractal analysis. Specifically, this study sought answers to the following questions: (1) What is the multi-fractality of the earthquakes from 1980-2013; (2) What is the spatial map analysis of the data gathered from 1980-2013, (3) When and where do most earthquakes occur in the Philippines; (4) How many earthquakes happen per year throughout the country in a period of 19802013; (5) What is the depth, intensity, and magnitude of the earthquake that affects the amount of damage; and Where did the strongest earthquakes in the Philippines occur?

METHODOLOGY

The descriptive method of research was used in this study and through Fractal Analysis, earthquake-prone areas were determined, identified, located, and mapped. Descriptive Research was appropriate for studies, which aimed to find what prevails in the present conditions or relationships, held opinions and beliefs, process and effects, and developing trends (Somoray, 2012). This descriptive research design was applicable in this study since the researcher relied only on the secondary data collected from the internet. These data were used for determining, identifying, locating and mapping earthquake-prone areas using

Fractal Analysis. This data analysis technique enabled the researcher to meaningfully describe many scores with a small number of numerical indices. This study was conducted in Guimaras State College-Salvador Campus. The researchers utilized the internet connection for the data mining procedure that they conducted in order to gather data for the study. Data for the earthquake incidents in the Philippine archipelago were obtained from various sources but mainly through the internet dating as far back as 1980-2013. The researchers note the places and dates of occurrences of earthquakes as well as its magnitude and intensity. The data were tabulated below for easy reference.

Date	Location	Magnitude	Intensity	Depth	Fractal Dimension	Interval
1980						
Jan. 2	Mindanao	6.9	IX	38.2 km	1.08048	
Jan. 4	Mindanao	5.9	VII	43.2 km	1	0.0666
Mar. 31	Luzon	6.4	VIII	29.4 km	1.08048	2.87
Jun. 9	Mindanao	6.1	VII	43.3 km	1.08048	3.27
Jun. 18	Mindanao	6.9	IX	29.5 km	1.14624	0.3
Jun. 19	Mindanao	6.0	VII	42.2 km	1	0.0333
1981						
Nov. 22	Luzon	6.0	VIII	34.3 km	0.830482	17.1
1982						
Mar. 12	Luzon	6.0	VII	20km	0.951839	3.7
Apr. 17	Babuyan Islands	6.3	VIII	25.2 km	0.5	1.17
Sept. 24	Reg.	5.9	VII	38.2 km	0.701839	5.2333
Dec. 28	Mindanao Babuyan Islands Reg.	6.1	VII	31.5 km	0.701839	3.13
1983						
May 6	Luzon	5.8	VII	39.8 km	1.17511	2.7
Jul. 14	Mindanao	6.2	VIII	43.2 km	0.976723	2.27
Aug. 11	Luzon	5.8	VII	30.7 km	1.11486	1.9
Aug. 17	Luzon	6.6	VIII	29.0 km	0.896241	0.2
Aug. 27	Mindanao	6	VII	15.0 km	1.09808	0.3333
Sept. 16	Luzon	5.5	VII	23.1 km	0.951839	1.6333
1984						
Apr. 10	Mindanao	5.6	VII	43.2 km	0.792481	6.8
Apr. 22	Mindanao	5.3	VI	18.8 km	0.976723	0.4
Sept. 22	Luzon	5.8	VII	20.7 km	0.976723	5
Nov. 27	Mindanao	5.8	VII	30.0 km	1.08048	5.17
1985						
Mar. 18	Mindanao	6.5	VIII	26.5 km	0.976723	3.3
Mar. 18	Mindanao	5.5	VII	40.5 km	0.896241	0
Apr. 24	Luzon	6.1	VII	5.3 km	0.951839	1.2
Aug. 4	Mindanao	6.4	VIII	21.5 km	1.04248	4.3333
Aug. 9	Luzon	6.1	VII	24.3 km	0.864858	0.17
1986						
Feb. 19	Babuyan Islands	6	VII	37.7 km	1.13089	5.3333
Jun. 17	Reg.					
Aug. 19	Mindanao	6.5	VIII	70.6 km	0.976723	4.93
	Mindanao	5.5	VII	40.0 km	0.896241	2.06
1987						
Feb. 11	Luzon	6	VII	32.2 km	1.08048	5.73
18-May	Mindanao	6.2	VIII	19.1 km	0.896241	3.2333
23-May	Mindanao	5.7	VII	22.4 km	1	0.17
Jun. 5	Phil. Island Region	6.1	VII	39.0 km	0.830482	0.6

Jun. 6	Phil. Island Region	6.4	VIII	38.0 km	0.864858	0.0333
Jun. 7	Batan Island Region	6.2	VIII	40.7 km	0.830482	0.0333
Jun. 14	Phil. Island Region	5.6	VII	44.5 km	0.75	0.2333
Jun. 18	Luzon	5.9	VII	13.9 km	1	0.13
Nov. 16	Mindanao	5.6	VII	22.0 km	0.92511	5.93
Nov. 18	Samar	6.3	VIII	15.0 km	0.896241	0.0666

Date	Location	Magnitude	Intensity	Depth	Fractial Dimension	Interval
1988						
Feb. 24	Cataduanes	7.2	X	40.0 km	1.02187	3.2
Feb. 24	Cataduanes	5.6	VII	43.1 km	0.92511	0
Apr. 5	Mindoro	5.8	VII	31.4 km	0.92511	0.37
Apr. 8	Mindoro	5.6	VII	37.1 km	0.92511	0.1
Jun. 19	Luzon	6.2	VIII	12.7 km	0.896241	11.37
Jul. 17	Batan Islands	5.8	VII	21.9 km	0.951839	0.93
Sept. 26	Region	5.4	VI	34.9 km	0.830482	2.3
Nov. 17	Leyte	6.6	VIII	18.9 km	0.896241	2.7
Dec. 4	Samar Babuyan	5.7	VII	22 km	0.951839	0.57
1989						
Aug. 10	Mindanao	6.1	VII	33.4 km	0.646241	8.13
Dec. 8	Phil.Islands Region	6.1	VII	21.0 km	0.701839	3.93
Dec. 15	Phil. Mindanao	7.5	X+	24.0 km	0.951839	0.2333
Dec. 16	Mindanao	5.5	VII	43.9 km	0.580482	0.0333
Dec. 17	Mindanao	5.9	VII	29.0 km	0.830482	0.0333
Dec. 20	Mindanao	6.5	VIII	34.2 km	0.864858	0.1
Dec. 20	Mindanao	5.5	VII	32.8 km	0.896241	0
1990						
Feb .8	Phil. Mindanao	6.7	VIII	26.0 km	0.976723	1.6
Feb. 8	Bohol	6.6	VIII	51.0 km	0.976723	0
Jun. 13	Phil. Mindanao	5.7	VII	79.0 km	0.75	5.17
Jun .14	Phil. Visayas	7.1	X	18.1 km	0.830482	0.0333
Jun.14	Panay	5.6	VII	18.4 km	0.792481	0
Jul.15	Mindoro	5.7	VII	26.5 km	0.830482	0.77
Jul.16	Luzon	7.8	X+	24.3 km	0.976723	0.3
Jul.16	Luzon	5.6	VII	18.8 km	0.792481	0
Jul.16	Luzon	5.7	VII	41.1 km	0.92511	0
Jul.17	Luzon	6	VII	21.0 km	0.976723	0.0333
Jul.17	Luzon	6.5	VIII	25.7 km	0.976723	0
Jul.18	Luzon	5.5	VII	13.5 km	0.951839	0.0333
Jul.20	Luzon	5.7	VII	22.6 km	0.951839	0.07
Jul.21	Luzon	5.7	VII	26.9 km	0.92511	0.0333
Jul. 23	Panay	5.6	VII	18.2 km	0.701839	0.07
Sept. 25	Mindanao	5.7	VII	43.7 km	0.896241	2.4
Oct. 25	Mindanao	6.3	VIII	44.8 km	0.830482	1.67
1991						
Feb. 18	Mindanao	6.7	VIII	35.1 km	0.896241	3.77
Apr. 24	Mindanao	6.2	VIII	21.5 km	0.896241	2.2
May 6	Leyte	5.5	VII	37.2 km	0.792481	0.4
Jun. 15	Luzon	5.7	VII	29.1 km	0.976723	1.3
Jun. 15	Phil. Luzon	5.6	VII	46.4 km	0.935785	0

Jun. 16	Jun. 16	5.4	VII	41.5 km	0.896241	0.0333
Sept. 4	Sept. 4	5.4	VI	21.2 km	0.830482	3.6
Nov.13	Nov.13	6.6	VIII	36.5 km	0.896241	2.3
1992						
17-May	Mindanao	7.1	X	35.5 km	0.976723	6.13
17-May	Mindanao	7.2	X	63.5 km	0.976723	0
20-May	Samar	5.4	VI	38.0 km	0.792481	0.1
Dec. 15	Mindanao	5.5	VII	40.4 km	0.646241	7.83
1993						
Feb. 3	Luzon	5.6	VII	24.1 km	0.792481	1.6
Apr. 9	Luzon	5.5	VII	25.3 km	0.92511	2.2
May 11	Mindanao	7	X	62.0 km	0.976723	1.07
May 15	Mindanao	5.8	VII	40.0 km	1	0.13
May 17	Leyte	5.7	VII	38.1 km	0.92511	0.07
Date	Location	Magnitude	Intensity	Depth	Fractal Dimension	Interval
Oct. 16	Mindanao	5.8	VII	38.4 km	0.896241	5.97
Oct. 30	Luzon	5.4	VI	40.5 km	1	0.47
Dec.10	Batan Islands Region	6	VII	14.6 km	1.16096	1.33
Dec.12	Luzon	5.5	VII	15.7 km	0.792481	0.07
Dec. 28	Samar	5.9	VII	40.9 km	0.792481	0.53
1994						
Mar.30	Mindanao	5.7	VII	40.9 km	0.896241	3.07
Jul. 5	Leyte	5.8	VII	35.7 km	0.861654	3.17
Oct. 12	Cataduanes	5.9	VII	25.4 km	0.646241	3.2333
Oct. 12	Cataduanes	6.4	VII	20.2 km	0.5	0
Nov. 14	Mindoro	7.1	X	32.0 km	1.17511	1.07
Nov. 15	Mindoro	5.5	VII	21.6 km	0.646241	0.0333
1995						
Jan. 6	Mindanao	5.8	VII	39.2 km	1.02187	1.7
Apr. 21	Samar	6	VII	28.0 km	1.08048	3.2
Apr. 21	Samar	6.8	VIII	30.7 km	0.92511	0
Apr. 21	Samar	7.1	X	34.6 km	1	0
Apr. 21	Samar	6.8	VIII	25.1 km	0.896241	0
Apr. 22	Samar	5.6	VII	33.4 km	0.646241	0.0333
Apr. 23	Samar	6.7	VII	28.8 km	0.75	0.0333
Apr. 24	Samar	5.4	VI	34.1 km	0.580482	0.3333
Apr. 24	Samar	5.7	VII	29.4 km	0.830482	0
Apr. 29	Samar	6	VII	16.3 km	0.864858	0.1666
May 5	Samar	7	X	26.5 km	0.792481	0.2
May 8	Samar	5.5	VII	41.5 km	0.792481	0.1
May 8	Samar	6.4	VIII	20.0 km	0.830482	0
May 17	Samar	5.6	VII	32.6 km	1.04248	0.3
May 24	Samar	5.9	VII	23.5 km	0.75	0.2333
Jun. 5	Luzon	5.8	VII	44.4 km	0.830482	0.37
Jun. 11	Samar	5.6	VII	36.2 km	0.75	0.2
Jul. 12	Samar	5.8	VII	34.1 km	0.830482	1.0333
Nov. 25	Mindanao	5.6	VII	38.3 km	0.75	4.43

1996						
Apr. 18	Samar	5.8	VII	36.7 km	0.792481	4.77
May 2	Luzon	5.4	VI	41.8 km	0.792481	0.47
Jun. 11	Samar	7.1	X	38.5 km	1.02187	1.3
Jun. 14	Samar	6.1	VII	28.4 km	0.792481	0.1
Jul. 1	Samar	5.5	VII	41.6 km	0.75	0.57
Jul. 30	Luzon	6	VII	33.8 km	1	0.97
Aug. 8	Samar	5.8	VII	32.8 km	0.75	0.27
Sept. 18	Mindanao	5.7	VII	20.0 km	0.830482	1.33
Sept. 20	Mindanao	6.4	VIII	40.1 km	0.830482	0.0666
Sept. 20	Mindanao	6.5	VIII	24.0 km	0.864858	0
Sept. 20	Mindanao	6.6	VIII	25.9 km	0.75	0
Sept. 20	Mindanao	6	VII	11.9 km	0.915184	0
Sept. 20	Mindanao	5.8	VII	29.6 km	0.896241	0
Sept. 21	Mindanao	5.6	VII	25.2 km	0.864858	0.0333
Sept. 25	Mindanao	5.8	VII	39.5 km	0.864858	0.1333
Oct. 2	Samar	6.4	VIII	20.0 km	0.92511	0.2333
Oct. 23	Mindanao	5.5	VII	28.6 km	0.701839	0.7
Oct. 31	Mindanao	5.5	VII	40.2 km	0.864858	0.2666
Oct. 31	Mindanao	5.6	VII	25.1 km	0.864858	0
Nov. 3	Mindanao	5.7	VII	44.2 km	0.830482	0.1
Nov. 4	Mindanao	5.8	VII	32.2 km	0.896241	0.0333
Nov. 4	Mindanao	5.6	VII	41.0 km	0.75	0
Date	Loaction	Magnitude	Intensity	Depth	Fractal Dimension	Interval
Nov. 4	Mindanao	5.9	VII	38.3 km	0.896241	0
Nov. 7	Mindanao	6.1	VII	34.1 km	0.75	0.1
Nov. 7	Mindanao	5.5	VII	15.0 km	0.646241	0
Nov. 9	Mindanao	5.5	VII	15.0 km	0.5	0.0666
Nov. 10	Mindanao	5.6	VII	40.2 km	0.5	0.0333
Nov. 20	Luzon	5.9	VII	11.5 km	0.896241	0.3333
Dec. 14	Phil. Islands Region	5.6	VII	31.3 km	0.646241	0.8
1997		6.8	VIII	90.90 km	1.06198	2.8333
Mar. 11	Mindanao	6.8	VIII	23.9 km	0.864858	0
Mar. 11	Phil. Islands	5.4	VI	42.5 km	0.792481	1.8
May 5	Region	5.9	VII	23.1 km	0.864858	0.2333
May 12	Luzon					
	Panay					
1997						
May 22	Babuyan Islands Reg.	6	VII	34.5 km	1.06198	0.3333
Sept. 15	Mindanao	6	VII	36.0 km	1.04248	3.7666
Sept. 17	Babuyan Islands	5.5	VII	36.6 km	0.646241	0.0666
Dec. 22	Region	5.5	VII	31.9 km	0.792481	3.1666
	Luzon					
1998						
Aug. 23	Luzon	6	VII	30.0km	1.06198	8.0333
Sept. 2	Mindanao	6.8	VIII	13.0 km	0.75	0.3
Nov. 5	Samar	5.9	VII	39.1 km	0.792481	1.1
1999						
Jun. 7	Mindanao	5.6	VII	31.4 km	0.951839	7.0666

Jun. 9	Mindanao	5.5	VII	41.5 km	0.896241	0.0666
Dec. 11	Luzon	7.2	X	40.0 km	0.896241	6.0666
Dec. 15	Phil. Islands Region	4.8	V	16.2 km	0.701839	0.1333
2000						
Feb. 3	Mindoro	5.4	VI	29.2 km	0.896241	1.6
Apr. 13	Phil. Island Region	5.9	VII	5.0 km	0.792481	2.3333
May 8	Leyte	5.6	VII	21.8 km	0.896241	0.8333
May 8	Leyte	5.4	VI	25.7 km	0.896241	0
Jun 19	Luzon	5.7	VII	25.4 km	0.896241	1.3666
Jul. 4	Batan Island Reg.	5.5	VII	27.5 km	0.701839	0.5
Jul. 16	Batan island Reg.	6.4	VIII	26.0 km	0.75	0.4
Jul. 18	Luzon	5.6	VII	31.7 km	0.976723	0.0666
Sep. 3	Mindanao	5.4	VI	39.7 km	0.75	1.5
Sep. 20	Sibuyan Sea	5.5	VII	19.0 km	0.646241	0.8666
Oct. 5	Mindanao	6.1	VII	31.5 km	0.830482	0.2
Oct. 8	Mindanao	5.7	VII	21.6 km	0.830482	0.1
Oct. 12	Samar	5.5	VII	29.6 km	0.830482	0.1333
Dec. 10	Babuyan Island Group	5.5	VII	36.2 km	0.5	1.9333
2001						
Jan. 1	Mindanao	7.4	X+	36.0 km	0.864858	0.7
Jan. 1	Mindanao	6.8	VIII	44.1 km	0.75	0
Jan. 2	Mindanao	6.4	VIII	24.0 km	0.792481	0.0333
Jan 12	Luzon	5.4	VI	24.0 km	1	0.3333
Jan. 12	Phil. Island Group	5.6	VII	32.9 km	0.830482	0
Mar. 13	Luzon	5.7	VII	26.0 km	0.830282	0.0333
2002						
Mar. 5	Mindanao	7.5	X+	31.0 km	0.951839	11.733
Mar. 8	Mindanao	5.8	VII	7.0 km	0.864858	0.1
Mar. 10	Batan Island Reg.	5.6	VII	25.0 km	0.701839	0.0666
Apr. 14	Mindanao	5.5	VII	44.0 km	0.864858	1.1333
Date	Location	Magnitude	Intensity	Depth	Fractal Dimension	Interval
May 13	Babuyan Island	5.5	VII	29.8 km	0.701839	0.9666
May 13	Babuyan Island	5.8	VII	32.9 km	0.701839	0
Jun. 14	Mindanao	5.6	VII	44.3 km	0.864858	1.0333
Sep. 3	Mindoro	5.7	VII	40.3 km	0.92511	2.6333
Dec. 30	Mindanao	6.3	VIII	16.8 km	0.701839	3.9
2003						
Jan. 6	Luzon	5.9	VII	40.2 km	0.896241	0.2
Feb. 15	Masbate	5.8	VII	6.8 km	0.830482	1.3
Feb. 15	Samar	6.2	VIII	9.0 km	0.792481	0

2003						
May 23	Leyte	5.6	VII	16.0 km	0.864858	8.2666
Jun 12	Mindoro	5.5	VII	43.4 km	0.75	0.6333
Jun 26	Masbate	5.9	VII	20.2 km	0.92511	0.4666
Jul. 1	Samar	5.9	VII	32.0 km	0.75	0.1666
Jul. 7	Batan Island R	5.5	VII	21.5 km	0.646241	0.2
Jul.11	Negros	5.9	VII	44.8 km	0.792481	0.1333
Nov. 18	Tacloban	6.5	VIII	35.0 km	0.896241	4.2333
Dec. 10	Luzon	5.4	VI	43.4 km	0.976723	0.7333
Dec. 18	Cataduanes	5.5	VIII	41.7 km	0.75	0.3
2004						
Feb. 26	Mindanao	5.4	VI	37.3 km	0.864858	2.2333
May 16	Mindanao	5.8	VII	15.8 km	0.896241	2.6666
Aug. 31	Mindanao	5.6	VIII	8.0 km	0.951839	3.5
2005						
Feb. 5	Philippines	7.1	X	532.9 km	0.646241	5.1666
Aug. 6	Samar	5.5	VII	24.4 km	0.701839	6.0333
Nov. 25	Mindanao	5.8	VII	41.7 km	0.896241	3.6333
2006						
Mar. 1	Mindoro	5.8	VII	22.3 km	0.92511	3.2
Mar. 27	Mindoro	5.6	VII	32.0 km	0.864858	0.8666
May 28	Babuyan Island	5.7	VII	23.0 km	0.830482	4.4
Oct. 20	Mindoro	5.8	VII	22.7 km	0.976723	0
Oct. 20	Mindoro	5.8	VII	25.3 km	0.92511	0
Oct. 20	Mindoro	5.6	VII	10.0 km	0.896241	0.0333
Oct. 21	Mindoro	5.9	VII	18.3 km	0.792481	
2007						
Feb. 12	Mindanao	6.1	VII	24.0 km	0.864858	3.6333
Apr. 25	Mindanao	5.7	VII	27.0 km	0.976723	2.3333
Jun. 14	Leyte	5.5	VII	10.0 km	0.646241	1.6333
Aug. 20	Philippines	6.4	VIII	8.0 km	0.646241	2.2
Nov. 27	Luzon	5.9	VII	35.0 km	0.896241	3.2333
Dec. 6	Samar	5.9	VII	37.0 km	0.864856	0.3
Dec. 9	Samar	5.6	VII	39.0 km	0.792481	0.1
2008						
Jan. 13	Luzon	5.7	VII	38.3 km	0.976723	1.1333
Feb. 19	Batan island	5.2	VI	12.2 km	0.646241	1.2
Mar. 3	Babuyan Isla	5	VI	10.0 km	0.864858	0.4666
Mar. 3	Phil.	6.9	IX	18.5 km	0.75	0
Mar. 20	Mindanao	6	VII	33.6 km	0.6462-41	0.5666
Mar. 28	Batan Island	5.8	VII	10.0 km	0.580482	0.2666
Mar. 29	Phil.	5.7	VII	46.6 km	0.646241	0.0333
Mar. 29	Batan Island	5.5	VII	12.5 km	0.701839	0
Jun. 1	Batan Island	6.3	VIII	31.4 km	0.896241	2.0666
Aug. 1	Mindoro	5.5	VII	144.2 km	0.792481	2
Aug. 15	Samar	6	VII	10.0 km	0.864858	0.4666
Aug. 25	Leyte	5.8	VII	49.9 km	0.830482	0.3333

Sep. 27	Mindoro	5.7	VII	10.0 km	0.92511	1.0666
Sep. 27	Mindoro	5.9	VII	10.0 km	0.701839	0
Oct. 1	Mindoro	5.6	VII	45.6 km	0.864858	0.1333
Date	Location	Magnitude	Intensity	Depth	Fractal Dimension	Interval
2009						
Apr. 4	Phil.	6.3	VIII	48.0 km	0.701839	3.6333
May 21	Mindanao	5.7	VII	55.0 km	0.646241	1.2333
May 29	Mindanao	5.7	VII	163.6 km	0.5	0.2666
Jun. 14	Mindanao	6.1	VII	35.0 km	0.5	0.5
Jul. 16	Mindanao	5.2	VI	57.9 km	0.5	1.0666
Aug. 12	Mindanao	5.7	VII	95.0 km	0.580482	0.8666
Sep. 18	Mindoro	5.9	VII	20.2 km	0.792481	1.2
Sep. 18	Mindanao	57	VII	27.3 km	0.792481	0
Oct. 18	Mindoro	5.6	VII	143.0 km	0.580482	1
Oct. 27	Mindanao	5.6	VII	35.0 km	0.75	0.3
Nov. 4	Mindanao	5.5	VII	110.0 km	0.580482	0.2333
Nov. 11	Mindanao	5.7	VII	23.6 km	0.701839	0.2333
Nov. 28	Mindanao	6	VII	74.8 km	0.5	0.2333
Nov. 29	Mindanao	5.6	VII	66.5 km	0.5	0.0333
Dec. 2	Samar	5.4	VI	39.2 km	0.580482	0.1
Dec. 30	Mindanao	5.4	VI	48.3 km	0.646241	0.9333
2010						
Jan. 21	Phil.	5.5	VII	35.0 km	0.5	0.7
Feb. 26	Mindanao	5.7	VII	117.3 km	0.5	1.1666
Mar. 2	Luzon	5.7	VII	32.1 km	0.580482	0.2
Mar 22	Luzon	5.9	VII	42.6 km	0.646241	0.6666
Mar 25	Mindoro	6	VII	16.0 km	0.5	0.1
May 31	Moro gulf	5.9	VII	41.7 km	0.896241	2.2
Jun 10	Mindanao	56	VII	48.2 km	0.5	0.3333
Jul 23	Moro gulf	7.3	X	612.2 km	0.5	0.4333
Jul 23	Moro gulf	7.6	X+	583.8 km	0.5	0
Jul 23	Moro gulf	7.4	X+	631.2 km	0.580482	0
Jul 24	Moro gulf	6.5	VII	555.3 km	0.5	0.0333
Jul 25	Moro gulf	5.2	VI	613.3 km,	0.646241	0.0333
Jul 26	Moro gulf	5.7	VII	625.9 km	0.646241	0.0333
Jul 29	Moro gulf	6.6	VIII	606.5 km	0.5	0.1
Sep 30	Babuyan Island	5.6	VII	15.3 km	0.646241	2.0333
Oct 4	Babuyan Island	5.5	VII	32.0 km	0.580482	0.1333
Nov 5	Masbate	5.6	VII	35.5 km	0.580482	1.0333
Dec 8	Mindanao	6.1	VII	69.6 km	0.701839	1.1
2011						
Mar 20	Babuyan	5.9	VII	31.4 km	0.646241	3.4
May 9	Mindanao	5.8	VII	35.7 km	0.5	1.9666
Jul 11	Negros	6.4	VIII	20.1 km	0.701839	2.0666
Jul 25	Luzon	5.9	VII	35.0 km	0.580482	0.4666
Nov 30	Luzon	6	VII	14.6 km	0.5	4.1666
2012						
Jan 14	Babuyan Island	5.7	VII	22.4 km	0.5	1.4666
Jan 17	Samar	5.7	VII	36.0 km	0.580482	0.1
Jan 28	Catanduanes	5.5	VII	48.8 km	0.646241	0.3666

Feb 4	Samar	5.6	VII	10.7 km	0.580482	0.2
Feb 5	Mindanao	5.2	VI	503.4 km	0.5	0.0333
Feb 6	Negros, Cebu	5.7	VII	11.0 km	0.75	0.0333
Feb 6	Negros, Cebu	5.6	VII	15.0 km	0.830482	0
Feb 6	Negros, Cebu	6	VII	15.0 km	0.701839	0
Feb 6	Negros, Cebu	5.8	VII	15.1 km	0.792481	0
Mar 16	Leyte	5.7	VII	35.4 km	0.792481	1.3333
Jun 15	Mindanao	5.7	VII	41.4 km	0.5	2.9666
Date	Location	Magnitude	Intensity	Depth	Fractal Dimension	Interval
2012						
Jun 15	Luzon	5.9	VII	28.0- km	0.580482	0
Aug 31	Eastern Samar	7.6	X+	34.9 km	1	2.5333
Aug 31	Phil.	5.5	VII	24.3 km	0.5	0
Aug 31	Phil.	5.6	VII	40.8 km	0.5	0
Sep 1	Phil.	5.4	VI	35.4 km	0.5	0.0333
Sep 3	Moro Gulf	5.8	VII	12.0 km	0.5	0.0666
Sep 3	Mindanao	5.7	VII	10.0 km	0.646241	0
Sep 4	Mindanao	5.2	VI	35.4 km	0.5	0.0333
Sep 4	Phil.	5.2	VI	36.9 km	0.5	0
Nov 2	Phil.	6.1	VII	38.0 km	0.5	1.9333
Nov 3	Mindanao	5.3	VI	25.0 km	0.5	0.0333
Dec 9	Phil Mindanao	5.6	VII	56.0 km	0.580482	1.2
2013						
Feb 16	Mindanao	6.1	VII	105.0 km	0.580482	2.1666
Apr 10	Batan Island	5.8	VII	4.2 km	0.5	1.8
Jun 1	Mindanao	5.6	VII	41.4 km	0.75	1.7
Jun 2	Mindanao	5.5	VII	43.9 km	0.646241	0.0333
Sep 6	Batan Island	5.9	VII	174.6 km	0.5	4.1333
Oct 15	Bohol	7.1	X	19.0 km	1.20184	1.3
Oct 15	Bohol	5.6	VII	6.7 km	0.701839	0
Oct 15	Negros, Cebu	5.7	VII	16.0 km	0.646241	0
Dec 3	Mindanao	5.6	VII	30.0 km	0.580482	1.6
Dec 31	Babuyan Island	5.7	VII	10.9 km	0.5	0.9333

Spatial Analysis

Spatial analysis of the data proceeded in the following manner: the researchers divided the observations by periods (from 1980-1999 and 2000-2013). The researchers then plotted the locations of the earthquakes on a map (of the Philippines) downloaded from the NET for each of time periods. The two (2) dimensional graphs were then subjected to a fractal analysis using the FRACKOUT.COM software available free from the NET. In order to do this, the images were converted into files whose extension was JPEG prior to inputting them into software that the resulting fractal dimensions were then compared for complexity analysis.

Temporal Analysis

Temporal analysis of the data set was performed using multi-fractal formalism introduced by Padua (2012). The earthquakes were computed and subjected to fractal analysis. The fractal spectrum was determined using equation $\lambda(s)=1-\log\square(1-\alpha)s$, $s=1/\log\square(x/\theta)$ and the spectral parameters: maximum A, asymmetry B, and width W, derived from the analysis of the shape of the singularity spectrum, was used to measure the complexity of the inter-event times. converted into files whose extension was JPEG prior to inputting them into software that the resulting fractal dimensions were then compared for complexity analysis.

FrakOut

FrakOut was a desktop application for calculating the fractal dimension of a shape e.g. the coastline of a country, using the box-counting method. The mental model used in this application was directly inspired by the section entitled How can a shape be 1.26-dimensional?, in the book "The Number Mysteries by Marcus du Sautoy", it used the idea of overlaying transparent sheets of graph paper over a shape, coloring the cells that cover part of the shape and counting the number of colored cells. The fractal dimension was calculated using the following expression: d=log□N/log□□2^z □; where the fractal dimension of the shape, N was the number of cells that cover the shape, and z was the zoom factor. The figure below shows how FrakOut was used in this study.

Statistical Package for Social Sciences (SPSS)

SPSS is a Windows-based program that can be used to perform data entry and analysis and create tables and graphs. SPSS is capable of handling large amounts of data and perform all of the analyses covered in the text and much more. SPSS is commonly used in the Social Sciences and the business world (SPSS Manual, retrieved on March 4, 2016). The descriptive data were analyzed using the SPSS software. The statistical tools used were frequency count, percentage, ranking and mean.

RESULTS AND DISCUSSIONS

Time series plot of inter-earthquake timed from 1980-2013

The time series plot shows evidence of multi-fractality. In the period from 1980 to 2013 was longer, thereafter, getting shorter thus, becoming more frequent. This implies the escalation of earthquake phenomena in the country. This indicates that for the past 14 years (2000-2013), the faults located in the Philippines have become more active. It is mainly because of the presence of the Pacific Ring of Fire, where active faults lines and underwater volcanoes were situated. Figure 1 shows how closely packed the intervals become. The government had undertaken precautionary measures to lessen the damages and casualties caused by unprecedented earthquakes. National government, especially the National Disaster Risk and Reduction Management Council (NDRRMC) had proposed programs that would be necessary to minimize the gargantuan and devastating effect of earthquakes. Earthquake drills had been the essential scheme taken by the national government and had been practiced by the archipelago since then.

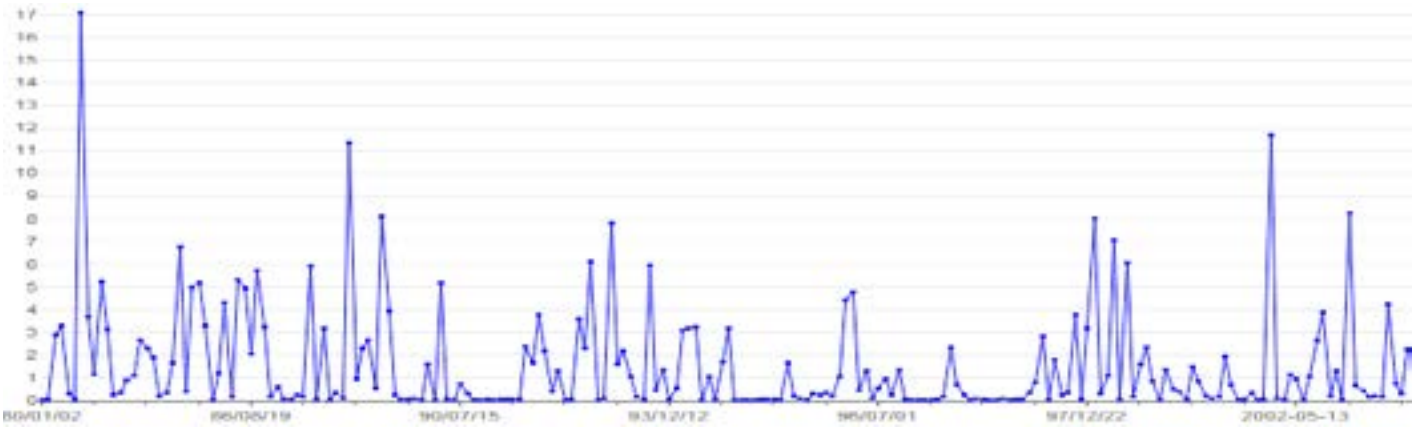


Figure 1.Time Series Plot of Inter- Earthquake Times

Table 2 presents the frequency of earthquakes per month from 1980-2013. Results revealed that the month of July had the greatest number of earthquakes, with a count of 40 or 12.5% of the total number of earthquakes. It was followed by September with 31 or 9.7%, May, November and December with 30 or 9.4%, June with 26 or 8.2%, March with 25 or 7.8%, February, April and October with 24 or 7.5%, August with 19 or 6% and January with 16 or 5%. There also appears to be some pattern evolving in terms of "month" in which the earthquake occurred. It implies that the usual earthquake occurs in the month of July, followed by September, May, November, December, June, March, April, October, August and lastly in January.

Table 2. Frequency of Earthquakes from 1980-2013 per Month

Month	f	%	Rank
Month	40	12.5	1
July	31	9.7	2
September	30	9.4	4
May	30	9.4	4
November	30	9.4	4
December	26	8.2	6
June	25	7.8	7
March	24	7.5	9
February	24	7.5	9
April	24	7.5	9
October	19	6	11
August	16	5	12
January	319	100.0	
Total			

Histogram of Estimated Fractal Dimensions of earthquakes from 1980-2013

The histograms of estimated fractal dimensions of earthquakes from 1980-2013 of Figures 2a and 2b presented a multifractal distribution. This means it is not a monofractal distribution because the points are not clustered in a single point. The multifractal distribution of the fractal dimensions implies at least two operant fractal dimensions: one operating at a lower scale (from 0 to 0.10) and another at higher scales (higher than the scale of 0.10). At a glance, the data for the groups 1980-1999 and 2000-2013 can be gleaned through the use of the histogram. The distribution shape achieved by the histogram is uneven, which denotes that the statistical data is not proportion based on the specification limits.

From here, the following information can be readily extracted:

In Figure 2a, most of the earthquakes that have fractal dimensions from 0.80- 1.00 also have a frequency of 3040. It simply means that in some of the earthquake incidents, the fractal dimension of an earthquake is directly proportional to its frequency and most of the earthquakes with a fractal dimension of 0.40-1.20 clustered in a close tight. Figure 2a implies that the earthquake that occurred from 1980-1999 appeared to be smoother and less disarrayed.

Figure 2b revealed an uneven and not- so tight cluster of bar graphs. The bars in the histogram follow a fluctuating system. It simply shows that the data are reasonably asymmetric, there appear to be significant outliers in the tails, and it seems reasonable to assume that the data are from approximately not a normal distribution. Figure 2b implies that the earthquakes that occurred from 2000-2013 appeared to be more chaotic and more dispersed.

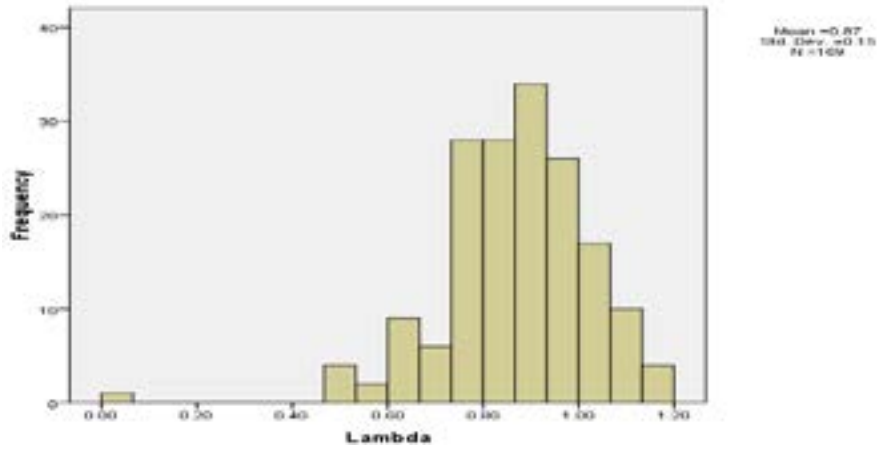


Figure 2a. Histogram of the estimated fractadimension of earthquakesfrom 1980-1999

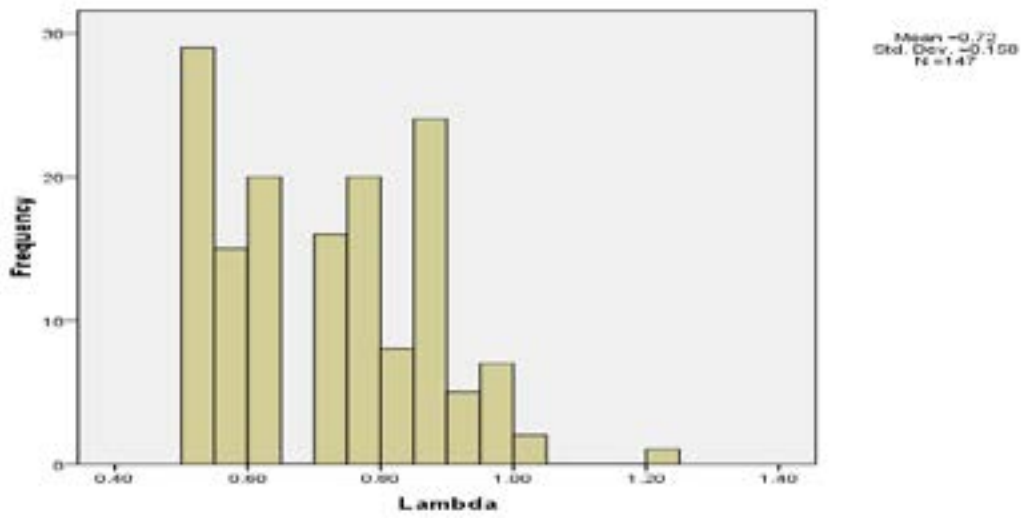


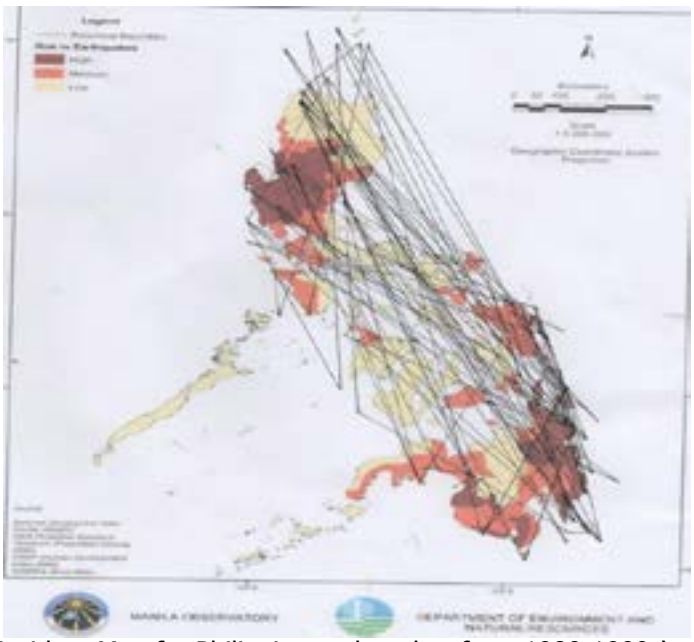
Figure 2b. Histogram of the estimated fractal dimensions of earthquakes from 2000-2013

Spatial Analysis

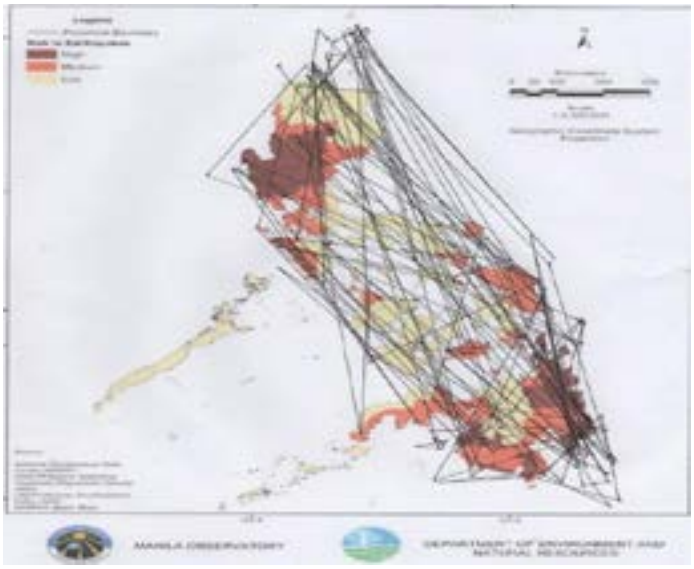
Graph 1 represents the earthquakes that occurred in the Philippines in two (2) categories: 1980-1999 and 2000-2013. The fractal dimensions are λ=0.872489 and λ=0.715773, respectively. Even though graph 1 shows many number of earthquakes, the lines connecting the areas where the earthquakes occurred appeared to be smoother and less dis-arrayed. Meanwhile, graph 2 compared to graph 1 showed a fewer earthquakes but the lines connecting the areas appeared to be more chaotic and more dispersed.

Graph 1 represents the earthquake incidents from 1980-1999. There were 168 earthquake incidents that occurred in these two decades. As shown in the graph, the lines in the map represent the frequency of occurrence. The darker and the more solid the lines are, the frequent the occurrence (in sequence) of earthquake incidents in these areas. It further revealed that most earthquakes occurred in the eastern part of the Philippine Archipelago. While Graph 2 shows the smoother feature of the graph representing the occurrence of 151 earthquake incidents in the period of 20002013. It revealed that more scattered or disarrayed lighter lines appeared most in the graph, which means the occurrence of the earthquakes in these years are frequent, do not repeat or interchange.

The spatial comparison of the two incident maps likewise revealed interesting patterns. In the first and smoother graph, the researcher found three (3) triangular configurations. The vertices of the triangles were found in Southern Mindanao, the Northernmost part of Luzon and in Eastern Samar. In the second and more chaotic graph, researchers found the same triangular configuration in Graph 1 but with more crisscrossing lines in them and the emergence of the next triangle with vertices in Romblon and in the Western part of Mindanao.



Graph 1. Incident Map for Philippineearthquakes from 1980-1999:λ= 0.872489



Graph 2. Incident Map for Philippine earthquakes from 2000-2013: λ= 0.715773

Relative Roughness

Figures 3a and 3b showed the comparison of two (2) Time-Series Plot versus Frequency Distribution from 19801999 and 2000-2013, respectively. It revealed that more earthquakes occurred in 1980-1999 with a fractal dimension (λ) of 0.872489 compared to the year 1999-2013 with a fractal dimension (λ) of 0.715773. More earthquakes occurred in the prior year, given the fact that it was the accumulation of earthquakes for the last twenty (20) years compared to the accumulation of earthquakes for the last fourteen (14) years.

Graph 1 and Graph 2 offer a graphical representation of the earthquakes that occurred for the past two decades (from 1980-1999 and 2000-2013). The researchers found out that the time interval for an exact number of 319 earthquakes that occurred in the past 34 years became shorter and shorter; thus, an implication can be concluded that the fault lines located in the Philippine archipelago become active.

The graph presents three different colors; the grey one presents the actual data and the blue one presents the model fit. The model fit is the pattern produced when the researchers underwent time series analysis of the data gathered for the past two decades. It presents a suitable outcome patterned to the actual data presented in the graph and the red lines present the predictions or the pattern that the next number of earthquakes would follow. The equation used to derive the predicted outcome of the earthquake for the years 1980-1999 and 2000-2013 is y = 0.0118x + 2.5603 and y = -0.0061x + 1.5781 respectively.

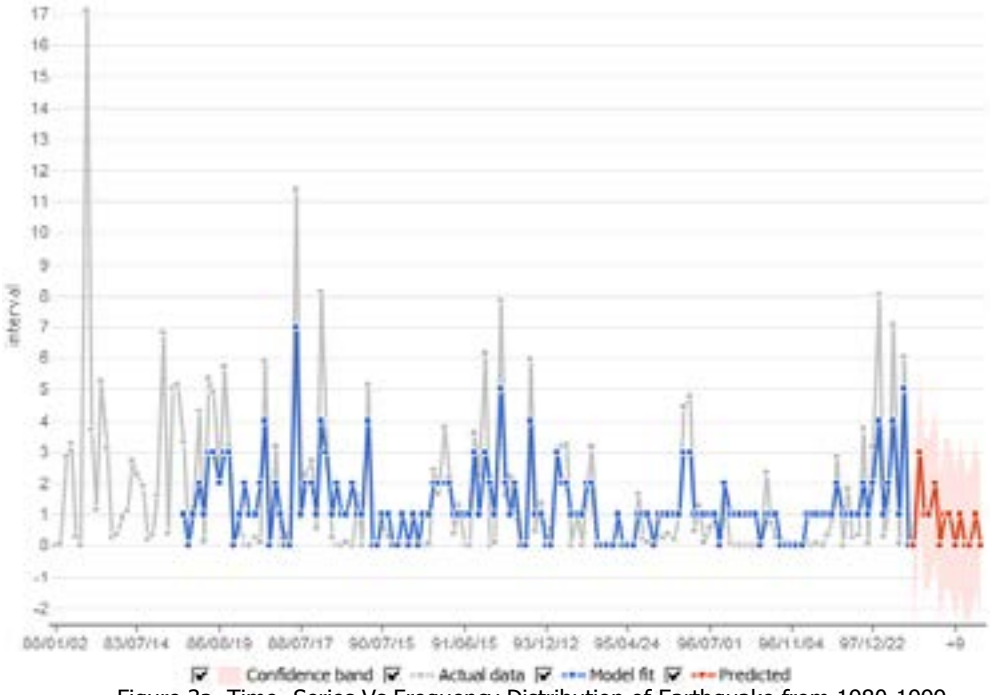


Figure 3a. Time- Series Vs Frequency Distribution of Earthquake from 1980-1999

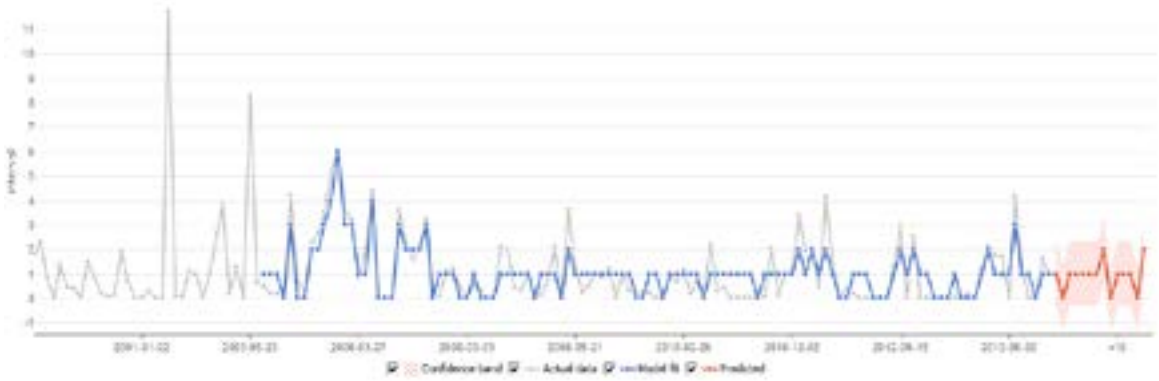


Figure 3b. Time-Series Vs Frequency Distribution of Earthquake from 2000-2013

Figure 3c showed a graph of Time- Series versus the Frequency Distribution of earthquakes from 1980-2013. It revealed a more clustered number of earthquakes in the year 2000-2013. The graph showed that frequent earthquakes occurred in the latter year with a mean of 2.6347. Relative
Roughness= ((λ 2-1))/((λ 1-1)) x 100%. In this case, RR= 222.904%, that is, the second graph is about 222% rougher compared to the first graph, given the fact that it has a smaller number of observations. Stated in another way, the relative roughness index indicates over 200% intensification of earthquakes for the last thirteen years. Active fault lines had immensely escalated for the last thirteen years.

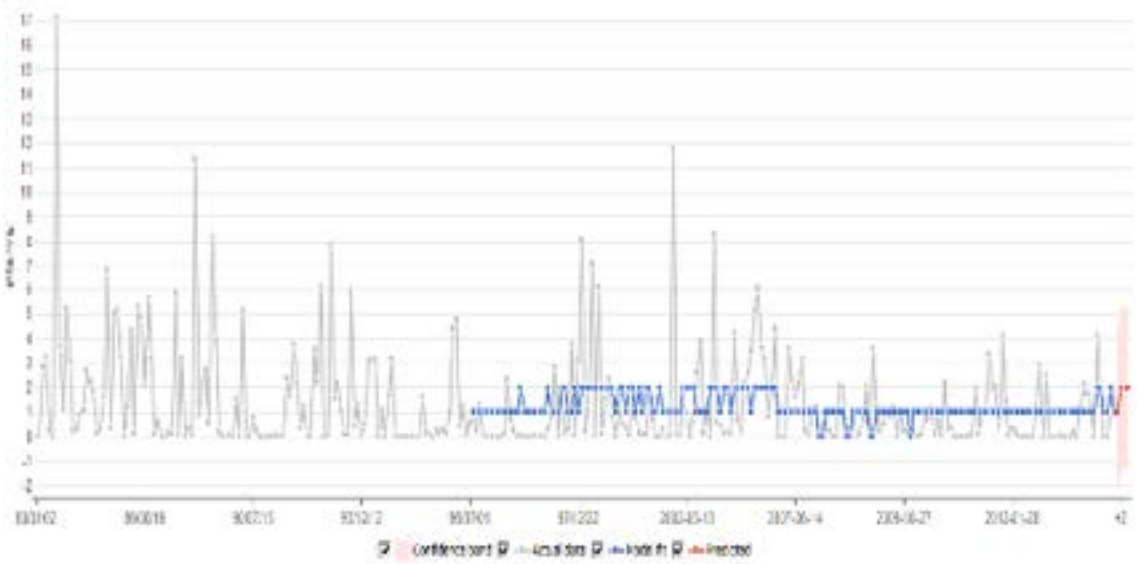


Figure 3c. Time- Series Vs Frequency Distribution of Earthquakes from 1980-2013

Frequency Distribution of Earthquakes in the Philippines

Data in Table 3 presents the frequency distribution of earthquakes that occurred in the Philippines from 1980-2013. The results revealed that Mindanao having 112 or 35.1%, was the area where most earthquakes occur. It was followed by Luzon, whose number of earthquakes reached 51 or 16% of the total earthquakes listed from 1980-2013, and Samar with 38 or 11.9%, Philippine Island Region and Mindoro with 22 or 6.9%, Babuyan Island with 16 or 5%, Bataan Island Group with 13 or 4.1%, Leyte with 11 or 3.4%, Moro Gulf with 9 or 2.8%, Negros with 8 or 2.5%, Catanduanes with 6 or 1.9%, Bohol, Masbate, and Panay with 3 or 0.9% and lastly the Sibuyan Sea and Visayas with 1 or 0.3% respectively. This implies that the presence of Mindanao Trench, popularly known as the Philippine Trench, contributes to a large number of earthquakes that occur in its vicinity.

Table 3. Frequency Distribution of Earthquakes in the Philippines

Places	f	%
Mindanao	112	35.1
Luzon	51	16.0
Samar	38	11.9
Philippine Island	22	6.9
Region	22	6.9
Mindoro	16	5.0
Babuyan Island		
Bataan Island	13	4.1
Group	11	3.4
Leyte	9	2.8
Moro Gulf	8	2.5
Negros	6	1.9
Catanduanes	3	.9
Bohol	3	.9
Masbate	3	.9
Panay	1	.3
Sibuyan Sea		

Frequency Distribution of the Earthquakes in the Philippines that occurred every five years from 1980 to 2013

Data in Table 4 presents the frequency distribution of earthquakes that happened in the Philippines every five (5) years from 1980-2013. Results revealed that the year 1995-1999 had the most number of earthquakes with a total of 84 or 18.8% of the total number of earthquakes. It was followed by the year 2010-2013 with 56 or 17.6%, 2005- 2009 with 51 or 16%, 20042009 with 54 or 15%, 1990-1994 with 45 or 14.1%, 1985-1989 with 34 or 10.7 and lastly, 1980-1984 with 25 or 7.8%. This implies that when the data were grouped into two (2) observations: 1980-1999 and 2000-2013 respectively, the researchers found out that more earthquakes happened per year in 1980-1999, with roughly 51.8 % of the total number of earthquakes given the fact that it covers two decades.

Table 4. Frequency Distribution of Philippine Earthquakes that happened every five years from 1980-2013

Year	f	%
1980-1984	25	7.8
1985-1989	34	10.7
1990-1994	45	14.1
1995-1999	64	18.8
2000-2004	54	15
2005-2009	51	16
2010-2013	56	17.6
Total	319	100

The Depth, Intensity, and Magnitude of the Earthquake that Affects the Amount of Damage

Table 5 presents the cross-tabulation of magnitude, intensity, and depth with damages caused by earthquakes throughout the Philippines from 1980-2013. Results revealed that when the magnitude was crosstabulated with the damages, the magnitude of 7.1-8 received the most number of damages with a valid percentage of 66.3%. When the intensity was cross-tabulated with the damages caused by earthquakes, it revealed that intensity X resulted in a large number of damages with a valid percentage of 44.4%. It was followed by intensity VIII with a valid percentage of 11.4%, intensity X+, and VII with a valid percentage of 22.2%, respectively. The depth of an earthquake, when cross-tabulated with the damages caused by the earthquake, revealed that 11km- 25 km-depth earthquakes, when accumulated, produces a large number of damages but nothing when compared to the damages caused by an earthquake with a 41km-45km- depth with a valid percentage of 11.1% and a damage cost of more than 10 billion.

This implies that the magnitude of an earthquake and its intensity were directly proportional to the damages caused by it. It means that the greater the magnitude and the intensity of an earthquake, the larger the damage is. On the other hand, the earthquake's depth has no significant relationship to the amount of damage. The depth of an earthquake may be shallow or deep, but the amount of damage was reliant only on its magnitude and intensity.

	Building and House	800-1000 Buildings	Damages 2000 and above Buildings	1M-5M	100M500M	10B+	Total	F	%
Magnitude									
6.1-7	1	0	0	0	2	0	3	3	33.3
7.1-8	1	1	2	1	0	1	6	6	66.7
Intensity									
VII	1	0	0	0	1	0	2	2	22.2
VIII	0	0	0	0	1	0	1	1	11.1
X	1	0	2	1	0	0	4	4	44.4
X+	0	1	0	0	0	1	2	2	22.2
Depth									
11 KM-15KM	1	0	0	0	1	0	2	2	22.2
16 KM-20 KM	0	0	1	1	0	0	2	2	22.2
21 KM-25 KM	1	0	1	0	0	0	2	2	22.2
26 KM-30 KM	0	0	0	0	1	0	1	1	11.1
31 KM-35 KM	0	1	0	0	0	0	1	1	11.1
36 KM-40 KM	0	0	0	0	0	0	0	0	0
41 KM-45 KM	0	0	0	0	0	1	1	1	11.1

Location of the strongest earthquakes in the Philippines

Data in Table 6 presents the location of the strongest earthquakes throughout the Philippines from 1980-2013. Results revealed that out of 319 earthquakes that happened throughout the Philippines from 1980-2013, the strongest recorded earthquake was situated at Luzon on July 16, 1990, with a magnitude of 7.8 and an intensity of X+. It was followed by earthquakes that happened in Moro Gulf last July 23, 2010, and Eastern Samar last August 31, 2012, with a magnitude of 7.6 and an intensity of X+ respectively. Third on the list was located at Mindanao last December 15, 1989, and March 5, 2002, with a magnitude of 7.5 and an intensity of X+ respectively. Fourth on the list was located at Mindanao last January 1, 2001, and Moro Gulf last July 23, 2010, with a magnitude of 7.4 and an intensity of X+ respectively. Fifth on the list was followed by Moro Gulf last July 23, 2010, with a magnitude of 7.3 and an intensity of X respectively. Sixth on the list happened in Mindanao last May 17, 1992, and in Luzon last December 11, 1999, with a magnitude of 7.2 and an intensity of X, respectively. Seventh on the list happened in the Visayas last June 11, 1990, in Mindanao last May 17, 1992, in Mindoro last November 14, 1994, in Samar last April 25, 1995 and June 11, 1996, Philippine Island Region last February 5, 2005 and Bohol last October 15, 2013 with a magnitude of 7.1 and an intensity of X, respectively. Lastly, the earthquakes that were located in Mindanao last May 11, 1993, and in Samar last May 5, 1995, with a magnitude of 7.0 and an intensity of X, respectively. Results imply that in the years from 1980-2013, Luzon ranked 1 with a magnitude of 7.8 and an intensity of X+.

Date	Location	Intensity	Magnitude	Rank
Jul. 16,1990	Luzon	X+	7.8	1
Jul. 23,2010	Moro Gulf	X+	7.6	2.5
Aug. 31,2012	Eastern Samar	X+	7.6	2.5
Dec. 15,1989	Mindanao	X+	7.5	4.5
Mar. 5, 2002	Mindanao	X+	7.5	4.5
Jan. 1, 2001	Mindanao	X+	7.4	6.5
Jul. 23,2010	Moro Gulf	X+	7.4	6.5
Jul. 23,2010	Moro Gulf	X	7.3	8
May 17,1992	Mindanao	X	7.2	9.5
Dec. 11,1999	Luzon	X	7.2	9.5
June 11,1990	Visayas	X	7.1	15.4
May 17, 1992	Mindanao	X	7.1	15.4
Nov. 14,1994	Mindoro	X	7.1	15.4
April25,1995	Samar	X	7.1	15.4
Jun. 11,1996	Samar	X	7.1	15.4
Feb. 5, 2005	Phil.Island Region	X	7.1	15.4
Oct. 15,2013	Bohol	X	7.1	15.4
May 11, 1993	Mindanao	X	7	16.5
May 5, 1995	Samar	X	7	16.5

CONCLUSIONS

From year 2000 to 2013, the faults located in the Philippines have become more active. It is mainly because of the presence of the Pacific Ring of Fire, where active fault lines and underwater volcanoes were situated. This means that it is not a monofractal distribution because the points are not clustered in a single point. The multi-fractal distribution of the fractal dimensions implies at least two operant fracta dimensions: one operating at a lower scale (from 0 to 0.10) and another at higher scales (higher than the scale of 0.10). More earthquakes that happened throughout the country from 1980-
1999 compared to the number of earthquakes that occurred in 2000-2013. The spatial analysis of the latter years produce a more chaotic and disarrayed lines. The spatial comparison of the two (2) incident maps likewise revealed an interesting pattern. These spatial features of the two graphs appear to demonstrate that: (1) the earthquakes are most likely to occur on places represented by the vertices of the triangles, and (2) places inside these triangles are also experiencing earthquake phenomena for the past 34 years. Fractal analysis of the earthquakes in the Philippines from 1980-2013 revealed that there is a tremendous escalation of earthquake incidences within the last 34 years inside the places represented by the vertices of the triangles: Southeastern Mindanao, Northernmost part of Luzon, Eastern Samar, Romblon and Western part of Mindanao. Moreover, the presence of Mindanao trench in the southeast part of the Philippines was one of the major contributors why a frequent earthquake occurs in the stated locality. This trench was considered an active trench because it is where the Galathea trench is situated, the second deepest trench in the world. Underwater volcanic eruption, plate tectonic movements, convection of the sea bed and formation of underwater volcanoes were one of the reasons why a frequent earthquake occurs in that place. The inclusion of the Philippines to the Pacific Ring of Fire also contributes to a large number of earthquakes that happened in the
Philippines. Active fault lines and active volcanoes are usually located in the said ring of fire, thus making the Philippines a vulnerable country to earthquakes. Another implication was that the magnitude of an earthquake and its intensity was directly proportional to the damages caused by it. On the other hand, the depth of an earthquake has no significant l relationship to the amount of damage. Results imply that due to the presence of West Valley Fault, a 100- kilometer fault which is one of the segments of an active fault: the Valley Fault System, stronger earthquakes tend to occur in Luzon. It also implies that Mindanao was one of the places where most of the strongest earthquakes occur because of the presence of the Mindanao Trench.

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