INTERNATIONAL JOURNAL OF EDUCATION RESEARCH

FOR HIGHER LEARNING

(formerly UIC Research Journal - International Edition)

Volume 22 Number 2 October 2016 Print ISSN 1656-0604 Online ISSN 2244-6532

ISSN 1656-0604 / Online ISSN 2244-6532

The International Journal of Education Research for Higher Learning is a biannual refereed journal published by the Research, Publication, and Innovation Center (RPIC) of the University of the Immaculate Conception, which tackles significant issues in the disciplines of humanities and languages, natural and health sciences, mathematics and physical sciences, engineering and information technology, education and social sciences, and business. This periodical is committed in giving the faculty members the apt avenue to fully develop their intellectual traits through the publication of their research outputs and other scholarly endeavors.

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Publisher
University of the Immaculate Conception
Bonifacio St., 8000, Davao City
Philippines
Telefax (63) (82) 227-37-94

INTERNATIONAL JOURNAL OF EDUCATION RESEARCH for Higher Learning

Volume 22, Number 2, October 2016

INTERNATIONAL JOURNAL OF EDUCATION RESEARCH for Higher Learning POLICY

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The INTERNATIONAL JOURNAL OF EDUCATION RESEARCH for Higher Learning is a bi- annual refereed journal published by the Research, Publication, and Innovation Center of the University of the Immaculate Conception, which is wholly committed to empower researchers within the academic community to realize their full potential in intellectual inquiry through the publication of their research outputs and other scholarly articles.

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- The paper is recommended for publication but subject to minor revisions.
- The paper is recommended for publication but subject to major revisions.
- The paper is rejected but maybe re-submitted after incorporating comments of the reviewers.
- The paper is rejected.

In case of any clarification from the referee regarding the revised work of an author, series of steps are to be undertaken to reach a final decision whether to publish the article. For instance, when the editor receives the manuscript with both positive and very negative reviews, the Editorial Board will seek an opinion of another expert to serve as a tie-breaker. In case of a tie, the board may invite the author to reply to clarify whatever question is being raised by the referee regarding the manuscript and the referee may reply if it is deemed necessary. Thus, in the end the Editorial Board secures that the exchange of communications between the author and the referee may not affect the decision of the referee regarding his or her opinion and that both parties shall remain after all to preserve confidentiality and avoid biases.

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Manuscript/s to be submitted to the Editorial Board of the INTERNATIONAL JOURNAL OF EDUCATION RESEARCH for Higher Learning should be written in English or Filipino and must be in MS Word. Articles written in Filipino must be accompanied by an informative abstract and summary written in English.

Manuscripts should be written single-spaced in 12-point type, Times New Roman font, 1 inch margin on all sides. The paragraph indention is five spaces. Manuscripts should be submitted online as digital/soft copies and e-mailed to esagarino@uic.edu.ph.

Manuscripts in general should be organized according to the disciplinal requirements of the paper. However, the general required structure should follow the IMRAD structure. It is also suggested that the order of presentation outlined below be followed:

Title Page – The title should be worded briefly and printed as Title Case. The first letters of each word should be capitalized except for articles (e.g. a, an, the), coordinate conjunctions (e.g. and, or, not, but) or preposition (e.g. of, in, on, between, after, before). However, the first and last words of the title should be capitalized regardless of part of speech. In titles with marked break in the form of punctuation, capitalize the word that immediately follows the break, regardless of part of speech.

Name (s) of Authors – Authors should identify themselves only in the title page that should precede the article for ease in undertaking the review process and ensure anonymity. Write the complete name with middle initials. Indicate whether the research is the portion of a thesis or dissertation and the sources of fund of the research.

For the running title, include a shortened version of the title of the article, not more than 40 letters in length, on the upper left-hand corner of each page.

Abstract – After the title page, print a 150 to 200-word informative digest of the background, objectives, methods used and significant findings of the article. The title preceding the abstract should also be printed in Title Case.

Keywords – The keywords for the study must at least indicate the discipline of the study, concepts studied, research design/method, and setting of the study. The keywords are printed in sentence case. There is no period at the end of the last word.

Abbreviations – For easy reference, an alphabetically arranged sequence of abbreviations and acronyms and their meanings are printed after the keywords. Avoid abbreviations in the title and abstract, although they may be used in graphs, tables, figures and legends. Acronyms are to be spelled out first and then enclosed in parenthesis at first mention. Avoid using acronyms and abbreviations as the first word of a sentence or a heading. Rewrite the sentence or spell out the term. Use abbreviations only for terms used at least three times.

Text – The body must have the following main sections and headings: Introduction, Methods, Results, and Discussion. Conclusion is optional, and must be under the Discussion section (last part) when included and must be sub-headed "Conclusion". Recommendations and Acknowledgment may be added at the end of the Discussion only when necessary. Results and Discussion may be combined as one section but should still clearly bear the elements of both. After the main body, these sections must follow: References (composed of sources from current content-covered or peer-reviewed journals within a 5-year time period) and Conflict of Interest Disclosure (if applicable).

Tables, graphs, photographs and illustrations should be submitted in separate files. Photographs, illustrations, and graphics should be of publishable quality (TIFF, or maximum quality in JPEG), and should be in 300 to 600 dpi with dimensions of at least 10 x 15 cm (4x6 in). Figures included in the article should be in black and white or grayscale only.

When placing legends on tables and graphs, they must be placed underneath using 10-point type, italicized and briefly stated. The captions for images and other illustrations must be encoded 2 spaces below; 12-point type, bold, and observes brevity.

Statistics – All statistical procedures, including methods of analysis, should be identified. Number of replications and sub-samples, transformations, and statistical tests should be stated. Tables of analysis of variance are not normally reported. Present the results of analyses in the appropriate tables or figures.

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Citations: The INTERNATIONAL JOURNAL OF EDUCATION RESEARCH for Higher Learning is using an in-text citation using an APA Format citation style (author-year format). Cited works must appear on the list of works listed in the "References" section.

1. In the text, works are cited as follows: author's last name and year of publication, with a comma, in parentheses.
2. For cited works that include more than one work by an author (or same co-authors) that is published the same year, the suffix a, b, etc., is to follow the date in the with-in text citation and in the "references" section.
3. When the author's name is is mentioned in the text, it may be not repeated in the citation.
4. Citation to institutional works should use acronyms or short titles where practicable.
5. If the paper referrers to statutes, legal treatises, or court cases, citations acceptable in law reviews should be used.

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Every entry should contain all information necessary or unambiguous identification of published work. Writers then are strongly advised to use references which are traceable online, with Digital Object Identifier (DOI), indexed by international databases, written by authors or agencies and not links.

The URL must be written at the end of the bibliographic entry and provides the date of retrieval and the link. Sources must be at least three years old except sources of theories, historical documents or chronologic presentations of literature review. Writers must refrain from using unpublished thesis or dissertation because a research is never finished unless published.

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1. Multiple publication of a manuscript is discouraged and unacceptable in the UIC Journal. The author who wishes to have his/her manuscript published in the UIC Journal should declare that such is not submitted somewhere else for publication.
2. For manuscript dealing with field surveys or experiments: if the additional documentation (e.g. questionnaire, case, interview schedule) is sent as a separate file, then all information that might identify the author(s) must be deleted from the instruments.
3. The manuscript should be submitted via email as Microsoft Word of PDF file to the Managing Editor at email address: esagarino@uic.edu.ph. The author(s) should need to submit the following separately:
   a. The manuscript's title page which contains information to identify the author (not forwarded to the reviewers),
   b. The manuscript with the title page and all other indentifying information removed,
   c. Any necessary supplement files such as experiment instruction, and
   d. A copy of research questionnaire or tools for referral by the editors and reviewers.
4. Revisions must be submitted within the date provided by the managing editor.

About the Cover

Technically a simple picture frame, the cover design symbolically represents the big picture perspective of the essence of research publication. Conceptualized by Mary Gabrielle G. Barluado, the minimalist design features only two figures: an outside border of solid color and an inner quadrilateral of gradient hue. The former stands for strong framework foundation of the Journal's publication process while the latter, with the imposing Journal name and monogram, symbolizes the variety of the featured articles. Starting 2016, this design will be applied on the covers of the new **International Journal of Education Research for Higher Learning** as a consistent identity; only the color will be changed per issue. Also, the picture frame was designed blank not only to emblematize the limitless possibilities in education research, but also to provide artistic freedom for the editors to feature a teaser photograph related to any of the published articles in the issue.

Mary Jane G. Barluado
Associate Editor

About the Monogram

The INTERNATIONAL JOURNAL OF EDUCATION RESEARCH for Higher Learning monogram depicts two feathers used in ancient quill pens. Intentionally juxtaposed to resemble the iconic Yin Yang symbol, this abstract form signifies the physicality and spirituality of the highest form of intellectual activity – research. Aside from capturing the dramatic glimpse of ancient writing, which is the essential aspect of any form of publication, this powerful image also depicts the interconnectivity and balance between the *multidisciplinary* and *international* characters of this research publication. In response to the UIC quest for quality research outputs that can pass international peer review process, this symbol was conceptualized to remind all researchers of UIC to commit to the truthfulness, credibility, and validity of information derived from the rigors of research writing. Created by Jo Caliph G. Rivera, this monogram is meant to become a unique emblem in every cover of the INTERNATIONAL JOURNAL OF EDUCATION RESEARCH for Higher Learning.

Renan P. Limjuco
Editor in Chief

CONTENTS

PREFACE

Science and math education and research are profoundly important in the advancement of societies. Yet achieving many of these advances are undermined by poor pedagogic innovations and lagging research applications. This second issue of the UIC Research Journal under its new name International Journal of Education Research for Higher Learning features 14 original research articles on science, mathematics, and related philosophy that are of translational relevance for societal progress.

On science education, two articles pose a leadership challenge for higher education institutions. The first is to look at the possibility of offering Biotechnology degree, as Prof. Mary Jane Barluado and colleagues found notable interest of surveyed students to enroll in the course should it be available. This could eventually help boost growth of biotechnology in the country which lags far behind its Asian neighbors in terms of research and development. The second is to benchmark curricular enhancement in Clinical Pharmacy, in consideration of Prof. Ferlien Baula-Brieta's findings regarding skill performance and clinical core competency level of surveyed Clinical Pharmacy graduates.

On mathematics education, three articles highlight the importance of integrating creative ways in teaching math concepts to new generation learners in response to 21st century pedagogic paradigm shift. The first, authored by Dr. Renan Limjuco and Prof. Jollicris Barangan, offers suspense in a math class by the utilization of cryptogram in matrix concepts to solve the inverse of matrices. The second, authored by Prof. Lourdes Plarizan, tips art integration using artworks of famous artists like Vincent Van Gogh, Leonardo da Vinci, Claude Monet, Juan Luna, and Fernando Amorsolo in solving and interpreting systems of equations. In the third article, Prof. Joel Jardeloza investigated the effect of web technologies in learning mathematics to the mathematics anxiety of learners.

The interlinked science, technology, engineering, and mathematics (STEM) education focusing on the acceptability and difficulty of the implementation of Senior High School - STEM strand of Sorsogon State College stakeholders, is emphasized by Dr. Aldrin John Estonanto in his article, as basis for possible intervention programs. This is timely to ease the transition years of the K-12 implementation in the country.

Of health and pharmaceutical industry translational relevance are four studies using widely available plant materials. In the first article, Prof. Karina Batu and Dr. Dela Merced investigated the radical scavenging activity and effect on liver function enzyme markers of Himbabao *(Broussonetia luzonica)* extract.

In the next article, Prof. Maureen Canda, showed Calamansi's *(Citrus microcapa)* antiangiogenic and antioxidant properties. Likewise, the other two articles present the potential bio-effects of coconut oil and different solvent extracts of Lagnub *(Ficus septic)*, respectively by Dr. Sonia Morales and Prof. Judee Nogodula and their colleagues.

Two articles give focus on nutrition and public health. One exposed the nutritional value and sensory appeal of horseradish-fortified commercial foodstuff as compared to their plain versions home-cooked with fresh horseradish leaves. Authored by Prof. Barluado and colleagues, the findings underscore the translational implication for researchers and authorities to initiate horseradish functional food development and production. Equally relevant is Prof. Valerie Fernandez's paper about community pharmacists' level of capability vis a vis their encountered challenges, which highlights the need for patient counseling and prevention of dispensing and medication error.

Finally, two articles use philosophical views in tackling relevant ecological issues. In one, Dr. Raymundo Pavo anchors on Arne Naess' Ecosophy in a plausible presentation of the overlap between ecology and philosophy. Another, authored by Profs. Asisclo Abonado and Alvin John Neyra, explicates the territorial dispute between China and the Philippines in the light of Jean-Paul Sartre and Gabriel Marcel Phenomenologies of Freedom.

On the whole, this issue's featured articles provide proofs that science and math research pertinently continues to influence planet earth's sustainable development and humanity's quality of life from the basic essentials like food and health to higher necessities like education and philosophical balance - of which everybody should take part whether in a personal, institutional, local, national, or transnational decision in a meaningful way. Our overarching recommendation is taking responsibility and accountability toward the ethos of first-class societal advancements.

Mary Jane G. Barluado
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Editor in chief

Knowledge, Attitude and Interest on Biotechnology of Davao City High School Students: Basis for the Possibility of Offering the Degree in Higher Education

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ABSTRACT

As a science that harnesses biomolecular processes to develop technologies and products that help improve lives, Biotechnology is globally regarded by scientists as the only sustainable solution to the universal problems of food shortage, climate change, and medical crises. Its slow growth in the Philippines is ascribed to very few universities offering Biotechnology degrees in the country. This study evaluated high school students' knowledge and attitude on Biotechnology, and their correlation to the students' interest to enroll in higher Biotechnology courses. Employing quantitative descriptive design and total enumeration of two Davao high schools' Grades 8 and 9 honor sections, 254 students were surveyed using a researcher-designed and expert-validated pretest-posttest questionnaire. The results reveal below average (M=2.5) pretest overall level of knowledge of students, which increased to high (M=3.83) at posttest after an intervention seminar. In terms of attitude, both students' pretest and posttest exhibit very high overall mean (4.1 and 4.4, respectively) indicating their strong approval of Biotechnology and its applications. Using Spearman's rho statistical test, pretest and posttest data revealed no correlation between the respondents' biotechnology knowledge and interest for the course. However, between their attitude and interest, significant moderate correlation are detected at both pretest ($r = .317$, $p < .05$) and posttest ($r = .283$, $p < .05$). These findings demonstrate a need to intensify promotion of the field in general education with concomitant biotechnology course and curricular offerings in higher education.

KEYWORDS: Biotechnology, level of knowledge and attitude, high school students, Biotechnology Degree, higher education, Philippines

INTRODUCTION

For the past centuries, the fields of medicine and technology have come a long way in the pursuit to find ways in pursuing scientific skills and intelligence. One of which is Biotechnology. The Biotechnology Industry Organization (2014) regards biotechnology as a field that deals with the application of biology to the fields of engineering, medicine, and technology. It harnesses cellular and bimolecular processes to develop technologies and products that would help improve the lives of human and the health of the planet. Modern biotechnology provides breakthrough products and technologies to combat debilitating and rare diseases, reduce our environmental footprint, feed the hungry, and use less and cleaner energy, and have safer, cleaner and more efficient industrial manufacturing processes.

With the biotechnology market predicted to be worth $727.1 billion by 2025 having growth rate of 7.4% (Grand View Research, 2017), the global demand for biotechnology is spreading like wildfire. For instance, the biotechnology report by Sherweb.com (2010) features UCLA Johnson Comprehensive Cancer Center having created a large, well-troop tumor-seeking immune system cells that locate and attack melanomas; Sweden's Karolinska Institutet, one of Europe's largest medical universities, having produced human stem cells in a chemically-defined environment without the use of cells or substances from animals; and Thomas Jefferson University Biotechnology Foundation Laboratories having identified a way to efficiently produce biofuel from tobacco plant leaves putting the plant to good use.

In these global advancements, the Philippines has levered its position as being cited by international agricultural experts as being a leader in the promotion of biotechnology in food production, having made it in the list of 18 so-called "mega-countries" that grow genetically modified (GM) or transgenic crops. According to Peter J. Davies, international professor of plant biology at Cornell University in New York, Philippines is at the forefront of testing and promoting GM transgenic crops, and adoption of transgenic corn among Filipino growers has reached a record 375,000 farmers in 2012 (Domingo, 2013).

Biotechnology programs in the Philippines started in 1980 with the formal creation of the National Institute of Molecular Biology and Biotechnology (NIMBB) at the University of the Philippines Los Baños (UPLB). Three other biotechnology institutes were established in 1995 within the University of the Philippines System. They are located in the UP Diliman campus to focus on industrial biotechnology, UP Manila to focus on human health biotechnology,

and UP Visayas to focus on marine biotechnology (Dela Cruz, 2000).

However, biotechnology degrees are only offered in University of the Philippines' Luzon and Visayas campuses. Although the University of the Philippines Mindanao campus was granted by the Department of Science and Technology (DOST) with funds for the establishment of laboratories for biotechnology, there is still no university or college that offers biotechnology as a course in Mindanao, particularly in Davao City. While information on biotechnology is limitless, the field's popularity remains low. Country expert and NIMBB's Dr. Cynthia Hedreyda, (2009) once pronounced that the only solution to this lack of biotechnology awareness is to institute biotechnology as a course in general education subjects.

Hence, in its effort to promote awareness and demand for Biotechnology courses, DOST's Philippine Science High School held a biotechnology educational forum in Davao City. DOST aims to 'popularize' the concept of biotechnology to elementary and high school students to disprove 'misinformation' about the field with the ultimate goal of making biotechnology contribute towards improving the quality of life of Filipinos (Nepomuceno, 2009).

In the outset, this would be more achievable knowing how biotechnology is perceived by high school students, as future scientists would be emerging from them. Many studies on basic education students' perceptions about biotechnology have been conducted in other countries (Bahri et al., 2014; Chen & Raffan, 1991; Fonseca et al., 2011; Usak et al., 2009) with results that might have contributed in one way or another to the respective country's biotechnology education and industry.

In the Philippine setting, there is a need to look at students' perceptions on this field to urge the Commission on Higher Education and universities to look at funding and opening new opportunities for students who seek degrees pertaining to biotechnology. In particular, there has been no study conducted in the Davao Region that investigates high school students' attitude, knowledge, and interest on modern biotechnology.

Study Objectives. This study specifically aimed to: a) describe the level of knowledge and attitude towards Biotechnology of junior high school students; b) find out the percentage of students who are interested to take Biotechnology higher education after senior high school; and c) determine significant differences based on sex, year level, and type of school; as well as significant relationships between the variables.

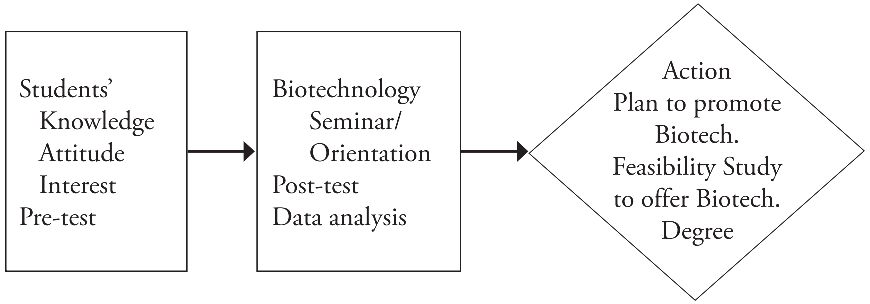

Figure 1. The Conceptual framework of the study

Figure 1 diagrams the input-process-output conceptual framework of the study. The students' knowledge, attitude and interest about biotechnology comprise the input. These variables were assessed by conducting a pretest to determine their outlook about the topic. The process involves giving a biotechnology seminar, conducting a posttest, and analyzing the data. The output is the result of the seminar and study findings, which includes an action plan for public promotion of biotechnology or a feasibility study to offer biotechnology degree.

METHOD

This study employed quantitative descriptive design. This was deemed appropriate as the objective was to obtain a picture of junior high school students' knowledge, attitude and interest on Biotechnology. Descriptive research is a purposive process of data gathering, analyzing, classifying and tabulating data about prevailing conditions, practices, beliefs, processes, trends and cause effect relationships and then making adequate and accurate interpretation about such data with or without aid of statistical methods (Study.com, 2015). The study determined the pretest behavior of high school students towards biotechnology through a survey, and whether it would change after a seminar intervention. The researchers desired that the outcome of this study will help understand their perception of biotechnology, thus become basis for possible action plan to promote biotechnology or a feasibility study to offer the course in the near future.

A survey and a seminar were conducted in two Davao City high schools with impressive track record in science education as proven by their winnings

in various regional and national science competitions. One is a private school, University of the Immaculate Conception - High School Department; another is a special science school of the government, Philippine Science High School. The study employed purposive sampling design in selecting only the honor sections of grades 8 and 9. Biotechnology is not yet a part of the Philippines junior high school curriculum; hence honors sections were selected since students in these classes are expected to have strong background on the foundation topics of biotechnology such as biology and chemistry.

Further, only grades 8 and 9 were included, and not grade 10 because grade 10 students are expected to already go to college in the next school year, whereas the grades 8 and 9 would be the first two batches to go through the implementation of the new K-12 basic education program. By total enumeration of grades 8 and 9 honor sections in the two schools, 254 students were utilized as respondents. The conduct of the study was pre-approved by the respective schools' heads / principals.

The main instrument in gathering the necessary data was a researcher-designed pretest-posttest questionnaire. It was validated by experts prior to its use. It was composed of three sections – the first asks about the respondents' profile, the second assesses their knowledge on biotechnology, and the third their attitude towards the methods, applications, and products of biotechnology, as well as their interest to take the degree after high school. The respondents' mean knowledge and attitude were determined using the equivalent scale of 1.00-1.79, 1.80-2.59, 2.60-3.39, 3.40-4.19, and 4.20-5.00, which have descriptive interpretation of very low, low, average, high, and very high, respectively. The survey and seminar intervention were done in February 2015.

Finally, the gathered data were statistically analyzed using descriptive and correlational techniques. Percentages, ranges, and weighted means were used to describe the knowledge, attitude, and interest of the students. Paired t test was used to determine existence of significant difference in the respondents' knowledge and attitude when they are grouped according to their profile. Spearman's rho was used to determine the relationships between the respondents' knowledge and attitude to their interest in enrolling to a biotechnology degree in higher education.

RESULTS AND DISCUSSION

Level of knowledge and attitude towards biotechnology

As shown in figure 2, the pretest level of knowledge of students in biotechnology subject is below average (M=2.5). Expectedly, after seminar intervention, their posttest level of knowledge became high (M=3.83), which implies that the students retained some knowledge about biotechnological concepts introduced during the seminar. In terms of attitude, the data reveal positive results – a high (M=4.13) pretest level of attitude which increased to very high (M=4.37) at posttest. Again, this indicates that the seminar on the subject somehow increased the students' appreciation of the subject.

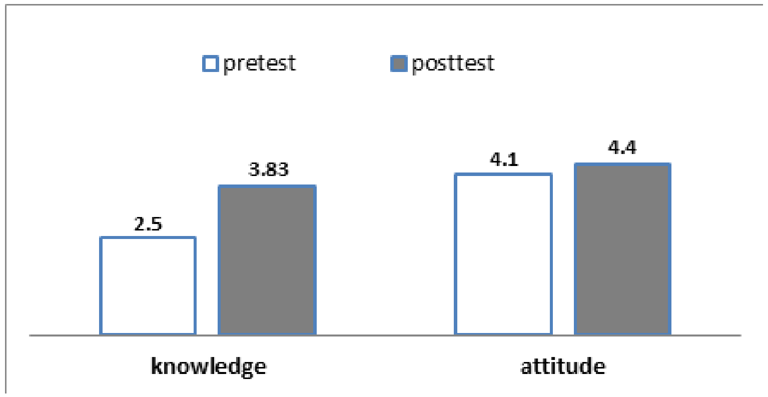

Figure 2. Mean level of students' knowledge and attitude about biotechnology

The low pretest knowledge of the students concurs with the results of previous researches. The study of Usak et al. (2009) on high school students' perceptions about biotechnology revealed students' poor knowledge regarding biotechnology and its various applications. Another study on multidimensional analysis of high school students' perception about biotechnology (Fonseca et al., 2011) revealed that despite students' acknowledgement of the importance of biotechnology, their knowledge and interest on the subject remain low.

In this study, the source of knowledge gained by the participating honor students about biotechnology is likely from the related content of Biology and Chemistry subjects that are introduced in school. Certain concepts of

biotechnology may be covered by individual science teachers but its applications in everyday life are uncommon which could have caused the below average level of biotechnological knowledge of students in pretest, and neither a very high level at posttest, which may be due to the abstract and molecular nature of biotechnology which the students could have found difficult to fathom.

This result could also indicate the limited access of biotechnology-related information by the students as majority of biotechnology-related information and knowledge is usually published in disciplinal scientific journals which high school students could find incomprehensible and too serious (Subahan et al., 2012).

This clearly reveals a gap in terms of efforts to educate, disseminate information, and raise awareness about biotechnology to various sectors, especially students. In particular, a more formal education should be provided through a well planned curriculum both in the basic and higher education. Chen and Raffan (1999) as cited by Bahri et al. (2014) stressed that a good biotechnology education outcome gives the students current and accurate knowledge with opportunities to form their own views based on their understandings of the risks, benefits and disadvantages of modern biotechnology.

Interestingly, despite limited knowledge, students' attitude about biotechnology is relatively higher. After the seminar intervention in particular, students exhibit very high level of attitude indicating their optimism and approval of the field and its methods, applications, and products. This is expected since the respondents, being honor students, are considered to have high level of appreciation of science. This result somehow deviates from the research findings of Dawson and Venville (2009) who found that students used emotional and intuitive reasoning in evaluating biotechnology issues, rather than rational reasoning. Bahri et al. (2014) explained that lack of exposure and relevant education relating to biotechnology result to students' difficulty in providing arguments critically, thus reflecting low scientific literacy.

Obviously, despite debate and controversies surrounding many biotechnological applications and lack of access to relevant information resulting in the community having different perceptions about biotechnology (Torres et al., 2006), the Davao junior high school honor students show consistency in being positive about biotechnology.

Percentage of students interested to take biotechnology higher education

In terms of interest to take Biotechnology degree after high school, the students are consistent with their reply both in pretest and posttest. Only about a third of them are interested to take the degree in higher education while most (70 %) replied they will not take the degree (figure 3). It should be noted however that it was the first time they heard about Biotechnology higher education course offering. Additionally, most of them have already made up their minds about what course to take after high school. Having not heard about biotechnology profession before, they have already set their minds on other professions or have nurtured other particular dreams, like being a doctor, lawyer, engineer, etc.

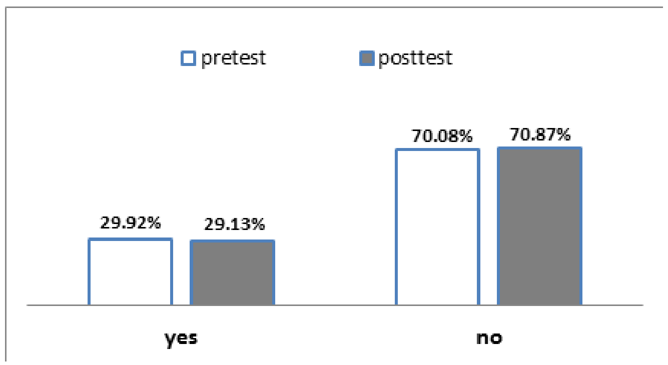

Figure 3. Percent of students interested to take Biotechnology Degree

Nevertheless, the 30% of the 254 respondents who said that they are interested to take biotechnology degree after high school can still be considered a big number – 75 students. Their enthusiasm about biotechnology profession should be more encouraged by at least an opportunity of having available option of biotechnology course in higher education. Additionally, biotechnology concepts should be introduced even as early as in junior high school to promote awareness about the field in the community, which in the long run will help the country lever a niche in the global biotechnology industry.

This is of essence considering the enormous global biotechnology business and the fact that the locus of future growth in this sector has shifted to the Asia-Pacific region, as the region's business revenue growth during 2010-2013

is approximately 19% higher than other regions in the world (Tanticharoen, 2015). In particular, the 2015 ASEAN Economic Community (AEC) allows free flow of goods, services, investment capital and skilled labor in the whole region. A strategic move for the Philippine government would be to create manpower in the field of biotechnology, which entails efforts to promote and expand biotechnology education.

Significant differences in knowledge and attitude based on respondents' profile

To test whether the respondents' level of knowledge about biotechnology is significantly different when they are grouped according to their profile, the data were subjected to t test analysis (table 1). Based on sex, male and female are significantly different in their level of knowledge both at pretest ($p = .001$) and posttest ($p = .007$). Grade level, whether grade 8 or 9, does not significantly vary the respondents' knowledge both at pretest ($p = .426$) and posttest ($p = .669$). Finally, school type (whether public or private) resulted to significant difference in the respondents' knowledge at posttest ($p = .040$) but not at pretest ($p = .541$).

Interestingly, these results contradict the findings of Usak et al. (2009) who found no significant difference in biotechnology knowledge between male and female high school students, and a significant impact of age on biotechnology knowledge and attitude, with the older students possessing higher knowledge and more positive attitudes. In this study, the possible reason why the younger grade 8 students' biotechnology knowledge is comparable to that of the older grade 9 students' knowledge is because biotechnology is not part of the high school curriculum leaving the students with personal-gained knowledge, which could equal in level considering that they are all honor students.

Overall, these results reveal that honor students' have similar knowledge on biotechnology which may not significantly vary with varying school type and year level, but varies between sexes. However, it should be taken into account that these honor students' biotechnology knowledge could expectedly be influenced by other external factors like their teachers and school environment as well as innate factors like study habits and reading interests.

Table 1. T-test for significant difference between respondents' pretest and posttest level of knowledge based on their sex, grade level and school

Measures		Paired variables Male & Female		Grade 8 & Gr. 9		Public & Private	
n	Pretest	121	133	133	121	81	173
	Posttest	115	139	136	117	82	172
$\bar{X}$	Pretest	2.62	2.65	2.56	2.71	2.63	2.64
	Posttest	3.78	3.88	3.71	3.98	3.55	3.97
SD	Pretest	0.70	0.55	0.58	0.66	0.64	0.62
	Posttest	0.80	0.66	0.69	0.75	0.67	0.72
t computed	Pretest	10.523		0.635		0.375	
α = 0.05	Posttest	7.492		0.183		4.263	
p	Pretest	.001		.426		.541	
	Posttest	.007		.669		.040	
Interpretation	Pretest	s		ns		ns	
	Posttest	s		ns		s	

Notably, analysis of the findings would imply that the students from the special science high school of the government gained more knowledge from the seminar intervention (pretest M=2.64 to posttest M=3.97, with gain of 1.33) than the private school students whose pretest and posttest mean level of knowledge were 2.63 and 3.55, respectively, with gain of only 0.92. Yet again, other external and internal factors could have contributed to the respondents' level of biotechnology knowledge.

On the other hand, in terms of the differences in the honor students' level of attitude towards biotechnology, they were revealed not significant across the respondents' sex, grade level, and school type. This implies that both male and female, grade 8 and grade 9, and public and private school students exhibit similar appreciation and positivism for biotechnology and its techniques, applications, and products.

Table 2. T-test for significant difference between respondents' pretest and posttest level of attitude based on their sex, grade level and school

Measures		Paired variables Male & Female		Grade 8 & Gr. 9		Public & Private	
n	Pretest	121	133	133	121	81	173
	Posttest	115	139	136	117	82	172
$\bar{X}$	Pretest	4.00	4.24	4.07	4.20	4.15	4.12
	Posttest	4.28	4.44	4.31	4.44	4.45	4.33
SD	Pretest	.80	.64	.78	.67	.67	.76
	Posttest	.72	.63	.70	.64	.61	.70
t computed	Pretest	0.412		1.032		0.723	
α = 0.05	Posttest	1.450		0.643		1.603	
p	Pretest	.522		.311		.396	
	Posttest	.229		.423		.207	
Interpretation	Pretest	ns		ns		ns	
	Posttest	ns		ns		ns	

Significant relationships of knowledge and attitude to interest in Biotechnology degree

By Spearman's rho statistical test, pretest ($p = .677$) and posttest ($p = .866$) data revealed no correlation between the respondents' biotechnology knowledge and their interest to take biotechnology degree (table 3). However, between their attitude and interest, significant but weak correlation are detected at both pretest ($r = .317$, $p < .05$) and posttest ($r = .283$, $p < .05$). These results imply that students' attitude, rather than their knowledge, influence more their decision whether to enroll in biotechnology higher education. Nevertheless, it should be considered that knowledge in a certain field is likely influenced by attitude towards the field.

Table 3. Spearman's rho test for significant relationship between students' knowledge and attitude about Biotechnology with their Interest to take Biotechnology higher education

Paired Variables	Pretest			Posttest		
	rho	p (2-tailed)	Interpretation	rho	p (2-tailed)	Interpretation
Knowledge & Interest	-.026	.677	ns negligible correlation	.009	.886	ns negligible correlation
Attitude & Interest	.317	.000	significant low correlation	.283	.000	significant low correlation

Correlation is significant at the .05 level; N = 254; ns = not significant

Though not statistically investigated in this study, the results that knowledge has negligible correlation and attitude has low correlation with interest to take the higher degree, could imply close relationship between the variables knowledge and attitude. The study findings of Klop et al. (2010) highlighted that students' attitude towards biotechnology is dependent on the knowledge and information that they possessed. They added that strong knowledge on the fundamental concepts of biology and genetics are able to build a strong scientific base which in turn will produce biotechnology literate students. Further, the mentioned study of Fonseca et al. (2011) on multidimensional analysis of high school students' perceptions regarding biotechnology showed positive correlations between biotechnology knowledge, attitude, interest and importance attributed to the field. Another study (Gastrow, 2010) established a correlation between knowledge and understanding in producing high levels of attitude, and that lack of knowledge and understanding of biotechnology will contribute to low levels of attitude towards biotechnology.

On the whole, the results of this study demonstrate that honor students exhibit highly favorable knowledge and attitude about biotechnology, and their percentage who are interested to take biotechnology degree in higher education is high enough to supposedly encourage the government or any higher education institution to consider looking at the feasibility of offering the degree or at least incorporating biotechnology concepts in the curricula of certain allied science courses. Also, there is a need to incorporate and intensify promotion of the subject in general basic education, as naturally, basic education students would expectedly proceed to higher education, and need to be informed that a biotechnology course and profession exist.

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International Journal of Education Research for Higher Learning
Vol. 22 No. 2 October 2016
Print ISSN 1656-0604
Online ISSN 2244-6532

Skill Performance and Clinical Core Competency Level of Clinical Pharmacy Graduates of the University of the Immaculate Conception: Basis for Curricular Enhancement

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ABSTRACT

Professional incompetence has always been a global threat; emerging problems arising in the practice needs immediate response. Specifically, in Clinical Pharmacy incompetence is extensive worldwide. ACCP states that incompetence is rooted down from the inadequate educational background and poor exposure of the students. Consequently, as a respond to the call, the objective of this study was to evaluate skill performance and competency levels of graduates and served as basis for curriculum enhancement. This descriptive study employed comparative analysis of the different competencies provided by the ACCP. It employed pre-validated questionnaire through OSCE. The respondents were the Clinical Pharmacy graduates of the University of the Immaculate Conception. Percentage Equivalent was used to distinguish the respondents' skill performance and competency level according to the adapted rating scale. One-way ANOVA was used in getting the significant difference between the five clinical core competencies. Post-Hoc Analysis was used to identify the core competency that needs to be addressed for curriculum enhancement. Results revealed that the only competency which demonstrated very good skill performance and with significant difference amongst other competencies was Communication Skill and Documentation. For that reason, it implied that the rest of the core competencies need to be reviewed to achieve the objectives and function as a basis for curriculum enhancement.

KEYWORDS: Clinical pharmacy education, skills performance, clinical core competencies, curriculum development

INTRODUCTION

A global problem is posted for all the professions most especially for health care professionals and this is the awakening health care incompetence among different allied health practitioners. This includes incompetence of Nurses, Doctors, and Pharmacists, including Clinical Pharmacists. The incompetence is seriously taken because it can result to a difficult scenario that can take a patient's life. Furthermore, it can lead to serious problems like incomplete medication review that allows medication errors leading to serious drug interactions, adverse drug events, and wrong administrations among other things.

Based from the study of the American Colleges of Clinical Pharmacy, the incompetence in the area can be traced to from the curriculum itself. According to the Journal of Current Pharmaceutical Research, Clinical Pharmacy curriculum's present state is a very sad thing. Due to the desire of addressing the heightened demands for clinical pharmacist in different areas, quality of graduates are jeopardized. Therefore, Curriculum modifications and various instructional strategies will have to be considered to facilitate the learning outcomes to gain expertise in pharmaceutical care (Fischer, 2004). The Accreditation Council for Pharmacy Education (ACPE) expects schools to commit Pharmaceutical Care and Pharmacotherapy as the template for the pharmacy curriculum.

Even though the Professional Competence of Clinical Pharmacy Graduates is not well established, the demands still overflow in different work. Therefore, the excellence of a clinical pharmacist among these fields must not be sacrificed. Hence, an enduring serious concern of the different colleges right now is to find ways on how to ensure and produce satisfactorily educated and highly skilled clinical pharmacists to address workforce demands.

As reported by the European Journal of Hospital Pharmacy, a long pending issue for enriching Clinical Pharmacy education already started its journey in the global practice even in Asian countries Clinical Pharmacy education reform and improvement. Such initiatives require the development of new subjects and teaching modules to equip clinical pharmacy graduates with up-to-date clinical knowledge.

In the Philippine setting, as reported by the Philippine Pharmaceutical Association, the country is facing the challenge to enhance the role of the clinical pharmacist in the provision of healthcare. This calls the attention of the University of the Immaculate Conception, one among of the few schools in the Philippines that offers Clinical Pharmacy Program. The University has been offering the course for almost a decade now. Thus, it has to ensure the community and the area of practice that it is producing graduates with competence and skills.

According to the strategic plan of the ACCP last 2007; its vision for the profession is that "pharmacists will be recognized as the preeminent health care professionals responsible for the use of medicines in the prevention and treatment of disease." It is their goal to ensure that clinical pharmacists are well educated and skilled in the workforce area. ACCP came up with a specific guideline to standardize all clinical pharmacy graduates to be fully equipped with skills for the different work areas. Hence, ACCP is determined to circulate the framework in elevating the profession of clinical pharmacy. Thus it is crucial for the different schools offering clinical pharmacy to respond to this challenge and conduct studies to evaluate their graduates according to their standards. It is in this context that the researcher would like to measure the levels of skill performance and competency of the Clinical Pharmacy graduates of UIC according to ACCP standards to be used as basis for the curriculum review and enhancement.

Study Objectives. This research measured the different competency skills that contributed to the overall performance of a clinical pharmacy graduates after the two semesters of regular classes and one summer of internship practice. The study examined the ability of the clinical pharmacy graduates to answer and respond to different situation and apply clinical learning strategies gained through the entire course.

Specifically, this investigation identified the skill performance level of the clinical pharmacy graduates based on ACCP standards, the competency level of all Clinical Pharmacy graduates according to the ACCP standards, and the overall competency level of all Clinical Pharmacy graduates. Moreover, significant difference in the five clinical core competency levels of the Clinical Pharmacy graduates was sought and also the clinical core competency needs to be addressed for curriculum enhancement.

This research has been conceptualized from the established clinical core competencies of the ACCP to standardize the level of excellence for all clinical pharmacy graduates. One very useful approach to educational evaluation is known as the CIPP, or Context, Input, Process, Product approach, developed by Stufflebeam. This provides a systematic way of looking at many different aspects of the curriculum development process. The CIPP Model is a simple systems model applied to program evaluation (Robinson, 2002).

Context evaluation includes examining and describing the context of the program you are evaluating and determining whether the proposed objectives will be sufficiently responsive to the identified needs. The context of this study that needs to be evaluated is the clinical pharmacy graduates incompetence (Robinson, 2002).

Input evaluation includes activities such as a description of the program inputs and resources (Robinson, 2002). The input involves the ACCP's clinical core competency for clinical pharmacy graduates. The core competencies contributed in the elevation of the level of clinical pharmacy graduates of the University of the Immaculate Conception. These are the ff: a.) Clinical problem solving, judgment, decision making; a patient specific approach, b.) Communication and education; involves integration of skill and knowledge c.) Medical information evaluation; understanding health care provision d.) Management of patient populations; focus on specialization of skills e.) Therapeutic knowledge areas; pathophysiology and drug management expertise.

Process evaluation includes examining how a program is being implemented, is performing, auditing the program to make sure it is following required guidelines. It provides information about what is actually occurring in the program (Robinson, 2002). The process applied in the study was objectively structured clinical examination. It involves different stations where the examinees undergo actual evaluation of skills, practical application of knowledge and quantification of all acquired knowledge. In general, the process helps in making implementing decisions.

Product evaluation includes determining and examining the general and specific outcomes of the program. Product evaluation is very helpful in making summative evaluation decisions (Stufflebeam, 2001). The product of the process will be the levels of skills performance and competencies of the graduates and eventually a revised curriculum for clinical pharmacy program.

METHOD

This study was a descriptive comparative type of research. With a descriptive comparative design, the researcher describes two or more groups for comparison. The study was conducted at University of the Immaculate Conception, the only school in Metro Davao and Mindanao today that offers Clinical Pharmacy Curriculum for the BS Pharmacy graduates and Registered Pharmacist in the locality and even nationwide.

There were 30 graduates of the Clinical Pharmacy program of UIC who served as respondents of this study. They passed the regular two semesters of the program and additional 360-hour internship practice during the summer, from June 2012 to May 2013.

In gathering the data from the respondents, interview and validated questionnaire were employed through Objectively Structured Clinical Examination, which was then rated and the mean scores were interpreted using the given scale matrices for skill performance and clinical core competency.

The data were analyzed using percentage, Analysis of Variance (ANOVA), and Post Hoc Multiple Comparison Test.

Rating scale for skill performance

Scale	Descriptive Rating	Interpretation
50-60%	Very Low Level	Skill did not reach passing standard.
61-70%	Low Level	Patchy performance of skill.
71-80%	Moderate Level	Acceptable performance of skill.
81-90%	High Level	Very good performance of skill.
91-100%	Very High Level	Excellent performance of skill.

Rating scale for clinical core competency

Scale	Descriptive Rating	Interpretation
50-60%	Very Low Level	Unsafe and unsuitable to progress.
61-70%	Low Level	Demonstrated some aspects of the competency however inaccuracies occurred. Have struggled with execution of competency.
71-80%	Moderate Level	Despite omissions / errors demonstrated in performance of competency is safe to progress.
81-90%	High Level	Majority of the technical aspects of the competency demonstrated. Examiner more than satisfied that candidate passed the station.
91-100%	Very High Level	Outstanding demonstration of technical and non-technical aspects of skill.

RESULTS AND DISCUSSION

To measure the competency among clinical pharmacy graduates, the researcher developed questionnaires that measured their competencies in the five areas. Overall results have been tallied and the computation of average scores is based on the acceptable criteria of 50% as the lowest average score and 100% as perfect score.

Skills Performance

Results in table 1 has revealed that the skills under clinical judgment and decision making skills of the graduates range from low level to very high level of competency. Of these, the skill assessment of patient-specific medical problems and specific drug therapy and therapeutic problems revealed the lowest scores (low level). The skill for identifying patient-specific medical problems is ideally learned through actual encounter with patients and hands on monitoring of patient's drug with an ideal ratio of 1 clinical pharmacist to a maximum of 5 patients (Litzelman, 2007). These ideals are not followed in the actual scenario; hence these can be attributable to the low scores of the students in these areas. Also, one factor according to PPHA that contributes to these low scores is lack of exposure of graduates to clinical cases since most of the hospitals here in the Philippines do not really involve clinical pharmacy in managing their patients.

However, very high level of skills levels on: Monitoring patients and collaboration with health care professionals were noted which indicates positive effect on the clinical pharmacy practice to inform allied health professionals and patients the importance of involving clinical pharmacy in managing patient's case. Very good performance in these skills can be attributable to good background in patient's physical assessment, laboratory test inferences, and drug induced adverse effects. Their confidence in this area keeps them inspired to collaborate with other health professionals, caregivers and with the patients too. Furthermore, moderate level of skill was demonstrated by the graduates in terms of designing a comprehensive drug therapy plan for patient specific problems. As stated in the ACCP's summary of competencies, Clinical Pharmacists unequipped with complete skills have hesitations to take the lead in terms of making decisions regarding patient drug therapy.

Table 1. Skill Performance levels of clinical pharmacy graduates under clinical judgment and decision making

Test Variables	Mean %	Qualitative description	Interpretation
Monitoring patients in the health care setting	90.37	Very high level	Excellent performance of skill.
Assessing patient-specific medical problems	69.58	Low level	Patchy performance of skill.
Evaluating patient-specific drug therapy and therapeutic Problems	67.50	Low level	Patchy performance of skill.
Designing a comprehensive drug therapy plan for patient specific problems	70.56	Moderate level	Acceptable performance of skill
Collaborating with patients, caregivers, and other health care professionals	90.56	Very high level	Excellent performance of skill

The practices of clinical pharmacy are triage between the patients and the medical practitioners. Consequently, it is important that the graduates develop effective communication skills and documentation interventions (Epstein & Hundert, 2002). Apparently, it has shown that the graduates of clinical pharmacy have revealed very high level of communication skills but moderately have intervened patient in terms of education and documentation. It matches to the study of Naughton (2012), even the respondents demonstrates very good performance in communication skill but their intimidations regarding insufficiency of their knowledge and their insecurities with the physicians hinders them to carry out their task of educating allied professionals and documenting suggested interventions. As such, the program must focus in developing the experiential learning among its graduates to fully develop its intervening skills in educating patients and documenting patient's medical record as declared in the study of the Pharmacy Department of General Hospital of Chengdu China.

Table 2. Skill performance levels of clinical pharmacy graduates under effective communication and effective interventions

Test Variables	Mean %	Qualitative description	Interpretation
Educating patients	79.58	Moderate level	Acceptable performance of skill
Educating other health care professionals	75.00	Moderate level	Acceptable performance of skill
Communicating effectively	92.62	Very high level	Excellent performance of skill.
Documenting interventions in the patient medical record	76.67	Moderate level	Acceptable performance of skill

Results in table 3 clearly indicate that graduates have high level (very good performance skills) in retrieving biomedical literature using appropriate search strategies. This means that the program has significantly provided learning materials and references so that its graduates can evaluate the needs of the patients. Also, with the emerging high technology nowadays, biomedical literatures can be very accessible to everyone thus making their skills in this area remarkable. However, graduates have shown moderate level in integrating data obtained from multiple sources to derive an overall answer. Thus, it is has been understood as patchy performance in interpreting biomedical literature with regard to study design, methodology, statistical analysis, significance of reported data, and conclusions. Even though it is very easy to retrieve literature, it also needs to be understood and applied to the profession. In this area, the respondents have difficulty comprehending the details of these biomedical data and their impact. Nowadays, professionals' outlook towards biomedical studies is superficial. In order to justify the validity of relevant drug recommendations it must be proven by biomedical studies before it must be implemented (Dobesh, 2006). This calls for immediate action in the clinical pharmacy program to strengthen the capacity of its students in reading and fully understanding cases provided in the literature and other references.

In terms of management skills, Table 3 shows that the graduates have moderate skill performance level in committing themselves to become a lifelong learner which could mean low level of interest in pursuing a career in clinical pharmacy. This is due to the fact that clinical pharmacy is not fully practiced in the Philippines. As reported by PPHA President Leonila de Ocampo in Philippine Inquirer, only five hospitals in the country practice it formally.

Table 3. Skill performance levels of clinical pharmacy graduates under medical information evaluation and management skills

Test Variables	Mean %	Qualitative description	Interpretation
Demonstrating the commitment to become a lifelong learner	79.58	Moderate level	Acceptable performance of skill
Retrieving biomedical literature using appropriate search strategies	83.33	High level	Very good performance of skill
Interpreting biomedical literature with regard to study design, methodology, statistical analysis, significance of reported data, and conclusions	62.78	Low level	Patchy performance of skill.
Integrating data obtained from multiple sources to derive an overall answer	74.17	Moderate level	Acceptable performance of skill

Table 4 clearly has indicated that graduates have moderate skills performance level in evaluating patient's safety and drug therapy and critical pathways which calls for immediate attention in clinical pharmacy program that graduates need to experience managing special patient population to ensure that graduates possess strong background in this aspect (Changming, 2004). It confirms the view of Poloyac, et al. (2011) that clinical pharmacy graduates lack these specialized skills. As such, experiential knowledge must be fully established and enhance its potential in managing special patient population.

Table 4. Skill performance levels of clinical pharmacy graduates under management of special patient population

Test Variables	Mean %	Qualitative description	Interpretation
Evaluating Patient safety and drug therapy	71.67	Moderate level	Acceptable performance of skill
Critical pathways	79.29	Moderate level	Acceptable performance of skill

Table 5 shows that the graduates have demonstrated very good performance skills in applying disease-oriented knowledge but moderately established competency in demonstrating competence in the pharmacotherapy. It is related to the findings of Carico et al. (2008), that Clinical Pharmacy graduates' knowledge on pharmacotherapy is not demonstrating high competence compared to what is expected from them. Furthermore, these pharmacotherapy skills are mostly obtained through training and experience in biomedical, pharmaceutical and clinical sciences which the program must provide. Lack of exposure in managing elderly and pediatrics are big factors that affect the development of their skills.

Table 5. Skill performance levels of clinical pharmacy graduates under knowledge of pharmacology, disease management and pharmacotherapy

Test Variables	Mean %	Qualitative description	Interpretation
Applying disease-oriented knowledge	83.00	High level	Very good performance of skill
Demonstrating competence in the pharmacotherapy	70.00	Moderate level	Acceptable performance of skill

1. Competency Levels of the Clinical Pharmacy Graduates

The table below contains the data gathered for the objective no. 2, the average competency levels of the respondents in terms of ACCP standards.

Table 6. Competency levels of clinical pharmacy graduates

Test Variables	Mean %	Qualitative description	Interpretation
Clinical judgment and Decision making	77.53	Moderate level	Despite omissions / errors demonstrated in performance of competency, it is safe to progress.
Communication skills and Documentation	81.82	High level	Very good performance of skill
Medical information evaluation and management	74.70	Moderate level	Despite omissions / errors demonstrated in performance of competency, it is safe to progress.
Management of special patient population	76.52	Moderate level	Despite omissions / errors demonstrated in performance of competency, it is safe to progress.
Knowledge in pharmacology, disease management and pharmacotherapy	74.33	Moderate level	Despite omissions / errors demonstrated in performance of competency, it is safe to progress.

Unlike the study in the University of Pittsburgh (Poloyac, 2011) as discussed in Chapter 2 regarding core competencies where the respondents scored above satisfactory. Here in this study, the rating of the competency for the clinical pharmacy graduates has shown majority on moderate level, a minimum level of competency with interpretation of safety level to progress. This signifies that the respondents possess the skills yet they do not demonstrate it well enough to excel.

It correlates to the study of Jones (2002) regarding Critical Care Competency that differences in the level of different competencies clearly affects the holistic competence of professionals.

2. Overall Competency of the Clinical Pharmacy Graduates

The table below presents the data containing the summative percentage of the entire five competencies of the Clinical Pharmacy Graduates.

Table 7. Overall of the five competencies of clinical pharmacy graduates

Test Variables	Mean %	Qualitative description	Interpretation
Overall Mean	76.98	Moderate level	Acceptable performance of skill

Nevertheless, overall rating has revealed moderate level of competency among the graduates on the five competency criteria included in this research. Moderate level of skills is on acceptable criteria and a safe level. Jones (2012) suggested in his study that improvement in the curriculum has to be done to address this issue. The respondents need improvement that focused on graduates' Clinical judgment and Decision making, Medical information evaluation and management, Management of special patient population and Knowledge in pharmacology and pharmacotherapy. PPhA states that enhancement of clinical pharmacy competency can only be achieve if graduates are expose to various clinical cases and when the administrator of hospitals in the Philippines will learn to accept clinical pharmacist is important workforce in managing patient's case.

Inferential Statistics

Table 8. Significant difference in the core competency levels of the clinical pharmacy graduates

Source of Variation	Sum of Squares	Df	MS	F	P value	Decision*
Between	1229.46	4	307.365			
Within	6371.76	165	38.617	7.959	0.0001	Significant
Total	7601.22	169				

*Calculation was performed at the 0.05 level of significance

Statistical results has revealed that there is an existing significant difference ($p<0.05$) on the five competency skills of the clinical pharmacy graduates which have explained inconsistent competency of the graduates in the practice of clinical pharmacy. These results have explained that the five competency skills of the clinical pharmacy graduates significantly differ from each other which indicate that one or two competencies were fully demonstrated by the graduates while others needs immediate improvement. Due to the different levels of demonstration of the respondents' skills, their competency levels are really affected thus there are really areas that can be their strengths and definitely some areas are their weakness. The results here is related and supported with the study of Bancroft et al. (2008) about Outcome Based Education, competency has many aspects and there are areas where professionals excel and areas that needs enhancement.

Therefore, in order to pursue with the objective of the study, as basis for curriculum enhancement, derived from the study of Janke et al. (2011) regarding Refinement of strengths in a Pharmacy curriculum, strength finder and weakness finder assessment tool was applied. In this study, in order to determine which of the five competencies the graduates have demonstrated very good performance and poor performance, post hoc an analysis was conducted and results are shown in table 8.

Table 9. Post hoc multiple comparison test of the significant difference of the mean scores of the five clinical core competency levels of the clinical pharmacy graduates

	Comparison	Mean Difference	P value	Decision*
Clinical judgment & Decision making	Communication skills & Documentation	4.29	0.001	Significant
	Medical information evaluation and management	2.83	0.054	Not significant
	Management of special patient population	1.01	0.055	Not significant
	Knowledge in pharmacology, disease management & pharmacotherapy	3.20	0.056	Not significant
Communication skills & Documentation	Medical information evaluation and management	7.12	0.001	Significant
	Management of special patient population	5.30	0.001	Significant
	Knowledge in pharmacology, disease management & pharmacotherapy	7.49	0.001	Significant
Medical information evaluation & management	Management of special patient population	1.82	0.080	Not significant
	Knowledge in pharmacology, disease management & pharmacotherapy	0.37	0.070	Not significant
Management of special patient population	Knowledge in pharmacology, disease management & pharmacotherapy	2.19	0.070	Not significant

*Calculation was performed at the 0.05 level of significance

Post hoc analysis has shown that of the five competencies studied only competency on Communication skills and Documentation of the graduates have demonstrated very good performance skills. The interpretation for these findings connects to the findings of Kaulbach (2012) about validation of pharmacists' competencies. An immediate call for review of the program, to establish standards and performance indicators, to prioritize supports and education to maximize effectiveness the role and ensure that other criteria of clinical pharmacy competencies are properly addressed which includes: Clinical judgment and Decision making; Medical information evaluation and management; Management of special patient population and Knowledge in pharmacology, disease management and pharmacotherapy since clinical pharmacy graduates moderately demonstrated competencies in these areas.

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International Journal of Education Research for Higher Learning
Vol. 22 No. 2 October 2016
Print ISSN 1656-0604
Online ISSN 2244-6532

Students' Appreciation of Utilization of Matrix Concepts in Cryptogram and Performance in Matrix Operations involving Invertible Matrices

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ABSTRACT

The primary aim of this study was to determine the relationship between the degree of appreciation on the utilization of matrix concepts in cryptogram and the level of performance in operations of invertible matrices of the Discrete Mathematics students. The respondents were 14 third year students under the Information Technology Program of AMA Computer College. A questionnaire anchored on the Process Standards for Mathematics was administered to quantify the students' degree of appreciation of the utilization of matrix concepts in cryptograms with respect to the enhancement of certain skills embedded in the process standards. A test composed of matrix operations and cryptogram exercises was conducted to measure the performance of the students in invertible matrices. The findings revealed that the students' degree of appreciation of the utilization of matrix concepts in cryptogram and their level of performance in matrix operations involving invertible matrices are both high. Overall, there is no significant relationship between the degree of appreciation and the level of performance. However, the specific areas of problem solving skills and mathematical communication established significant relationships with product and inverse matrices. Hence, the students' level of performance in the subject may be enhanced by embedding matrix concepts with concrete process applicable in real life situation, in teaching the subject.

KEYWORDS: Mathematics education, degree of appreciation, performance, cryptogram, inverse matrices, correlation, Philippines

INTRODUCTION

The Trends in International Mathematics and Science Studies (TIMSS) has reported a global poor understanding by learners of fundamental concepts in both mathematics and science. The TIMMS most recent completed survey was in 2011, which revealed that Korea, Singapore, Chinese Taipei, Hong Kong SAR, and Japan are the top five Asian countries with the highest scale scores in mathematics achievement at fourth grade and at eighth grade, with average achievement above the High International Benchmark of 550 in each case, using scale scores of 0-1000, even exceeding the scale center point of 500 of developed countries like Israel, Finland and the United States.

In the Philippines, TIMMS recorded dim scores of 345 and 378 in its most recent participation in 1999 and 2003, respectively. Sadly, the latter survey was participated in by the country's science high schools and the elite private institutions. With the Philippines' TIMMS test performance being consistently at the bottom 10 among 50 countries, the country clearly lags behind its foreign neighbors in terms of the learners' appreciation of both teaching and learning math concepts. This poor performance in math among Filipino learners could be attributed to their low interest and lack of appreciation in the subject.

Many teachers and students think that mathematics can only be taught in straightforward manner. This belief might be the cause why a lot of math learners still are unable to appreciate the subject because obviously their pre-conceived notion that math is difficult is never addressed. As a remedy measure, there has been an effort to shift from the traditional method to the more interactive approach of teaching science and mathematics lately in the global scenario (Silber, 2015).

In particular, there have been considerable interests to understand the appreciation behavior among mathematics learners to look for possible ways to improve performance. Math appreciation (learning maturation), a construct approximated by math maturity as defined by Moursund (2004), is brought about by a lot of things. It could be influenced by understanding, problem solving, theorem proving, precise mathematical communication, mathematical logic and reasoning, knowing how to learn math, problem posing, transfer of learning (being able to use one's mathematical knowledge over a wide range of disciplines and in novel settings) and interest (including intrinsic motivation) in math (Moursund, 2004). However, there are students who love mathematics because they have learned its structure immediately like a language. Thus, these students usually are recognized as the mathematically gifted ones. To them, mathematics

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is everything defined by its nature– sequential, developmental, intuitive, and difficult. Therefore, to the mathematically gifted ones, mathematics is just what really it is. Learners either love it or hate it.

On the other hand, there are also many students who need more motivation to see the beauty of math. This group of students should be immersed in a learning environment that somehow deviates from the traditional approach of math instruction.

A previous work of the author described an exploratory pedagogy which is basically a creative learning enhancement designed to develop an appreciation for mathematics (Limjuco, 2012), which revealed interesting patterns that indicate positive impacts of creative learning enhancement to mathematics comprehension and appreciation by learners. Through the investigation, participants realized that math is a tightly-woven structure that begins with a simple concept but rapidly evolves into something complex, and they also realized that comprehension could be achieved for a time in a continuum. They felt that the growth of knowledge precedes the level of appreciation and these findings seemed to establish that learning appreciation maturation is a function of time and exposure to meaningful classroom activities. Indeed as confirmed by findings of other researchers on pedagogy and learning styles, supplementary activities elevate the appreciation of math concepts and improve the analytical skills of the students regardless of their learning styles.

In consideration of the above, this current study considers the use of matrix concepts in cryptogram as a possible strategy to increase learners' appreciation of math concepts, by anchoring on the concepts of constructivism and discovery learning.

Constructivism points out the need to increase the level of self-motivation and personal involvement among learners. In mathematics, a constructivist always seeks to impact deeper comprehension of the subject matter (Vygotsky, 1978; Vygotsky, 1986; Crawford & Deer, 1993). This job is often channeled to math teachers to realize through the infusion of enriched learning activities in their usual curriculum inside the classroom (Confrey, 1990). These student-centered curricular trends uphold the idea that effective instruction is not achieved by explaining how students take in and process teacher-transmitted information. Instead, it explains how students actively construct knowledge in ways that satisfy constraints inherent in instruction (Cobb, 1988). In support, Hodges and Conner (2011) pointed that an important consideration in understanding students' identification with mathematics is the extent to which activities are designed to be learner-centered using available technologies and how teachers use them to craft learning opportunities for students.

On the other hand, discovery learning is an inquiry-based learning theory that takes place in problem solving situations where the learner draws on his or her own past experience and existing knowledge to discover facts and relationship and new truths to be learned. Students interact with the world by exploring and manipulating objects, wrestling with questions and controversies, or performing experiments. As a result, students may be more likely to remember concepts and knowledge discovered on their own (Bruner, 2014).

In this study, a student-centered strategy involving cryptogram deciphering to increase learners' involvement and motivation (as Constructivism points out) is employed. Consequently, the learners' enriched experience from their heightened involvement and motivation is expected to help them better understand matrix concepts and solve problems on inverse matrices (as underscored by discovery learning).

In particular, a cryptogram is a type of puzzle that consists of a short piece of encrypted text. Frequently used are substitution ciphers where each letter is replaced by a different letter or number. To solve the puzzle, one must recover the original lettering. One fascinating application of matrix concepts is seen in cryptography. For a particular passage for example, encoding requires assigning a number to each letter in the alphabet: A = 1, B = 2, C = 3,…, Z = 26, and a space = 0. Hence, the numerical equivalent of the word MATH is 13, 1, 20, and 8. The numerical equivalent of the message is then converted into a matrix. Finally, an invertible matrix can be used to convert the message into code. The multiplicative inverse of this matrix can be used to decode a message (Blitzer, 2004). Mathematically, the process is understood as follows:

The matrix equation $AX = B$ can be solved using A^{-1} if it exists.

$AX = B$	This is the matrix equation
$A^{-1}AX = A^{-1}B$	Multiply both sides by A^{-1}. Because matrix multiplication is not commutative, put A^{-1} in the same left position on both sides.
$I_nX = A^{-1}B$	The multiplicative inverse property tells us that A-1 A = I_n
$X = A^{-1}B$	Because In is the multiplicative identity, $I_nX = X$.

Thus, it can be seen that if $AX = B$, then $X = A^{-1}B$.

By using cryptograms, the researchers hope to ignite math learners' appreciation of specific concepts in linear algebra such as multiplication of matrices and determination of the inverse of matrices.

Study Objectives. The primary aim of this study was to determine the degree of appreciation on the utilization of matrix concepts in cryptogram (in terms of problem solving skills, mathematical communication, mathematical connection with reasoning, and mathematical representation) and the level of performance in invertible matrices (i.e., product and inverse of matrices, and encoding and decoding) of the Discrete Mathematics students. Also, this investigation determined whether the degree of appreciation is significantly correlated with the performance of the students.

The conceptual framework of the study (figure 1) shows students' degree of appreciation of the utilization of matrix concepts in cryptogram as the independent variable, while the level of performance in invertible matrix serves as the dependent variable. This study posits that students' performance in solving problems on invertible matrix can be improved by their degree of appreciation for utilizing matrix concepts in cryptogram.

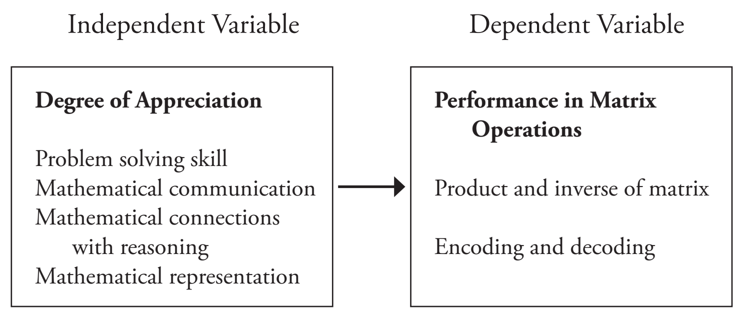

Figure 1. Conceptual framework showing the relationship between the variables of the study

The degree of appreciation pertains to the use of the different process standards for mathematics as defined by the National Council of Teachers of Mathematics (NCTM). This consists of the four principles namely, problem solving, communication, connection with reasoning, and representation.

Problem Solving is the process of applying a variety of appropriate strategies based on information provided, referenced, recalled, or developed in math operations. Communication processes pertain to organizing mathematical thinking coherently and clearly to peers, teachers and also using the language of math to express mathematical ideas precisely. Connection with Reasoning refers to recognizing and using links among math ideas as well as with other subjects such as the physical sciences, engineering, social sciences, and business; and how mathematical ideas interconnect and build on one another to produce a coherent whole. Representation involves the creating and using of multiple diagrams and symbols to organize, record, and communicate mathematical ideas; and interpreting mathematical phenomena to significantly expand the capacity to model and interpret physical, social, and mathematical phenomena (NCTM Process Standards for Mathematics, 2012).

Performance in matrix operations pertains to the scores of the students in the questionnaire consisting of items designed to assess their knowledge on product and inverse of matrix determinations and encoding and decoding techniques.

METHOD

The study made use of descriptive-correlation method of research. According Stangor (2011) descriptive research is designed to provide a current snapshot using descriptive statistics analysis of the data being gathered, in the case of this study, students level of appreciation an pefomance on cryptogram problems. Correlation, on the other hand aims to determine relationships among two or more variables (Lomax & Li, 2013) with a goal to examine the nature and degree of relationships among the variables to make a prediction. In this study the researcher wanted to establish whether the degree of appreciation on utilization of matrix concepts in cryptogram is significantly related to their performance in invertible matrices, specifically in the determination of the inverse of the matrix.

The study was conducted at Davao City, specifically in the University of the Immaculate Conception located at Bonifacio Street, Davao City. Specifically, this study was pursued at the selected higher education institutions particularly in the premises of the UIC Bonifacio Campus and the AMA Computer College where the concerned mathematics students were found. Approval of the Dean of AMA Computer College regarding the participation of the students of their institution was secured

The study respondents were 14 third year students under the Information

Technology Program of the AMA Computer College. They belong to a class that is purposively selected based on the criteria that it a) is a class for regular students; b) is a Discrete Mathematics class; and c) should have covered the topics matrices, determinants, and encryption or cryptogram. The respondents participated in the study voluntarily, were made fully aware of the study objective, their extent of participation, and that they may withdraw any time without any demand for explanation. Also, confidentiality of their responses was assured as no personal data were collected from them and their names were omitted to safeguard their identity.

This research used an adapted questionnaire and an examination tool. The first one was the Questionnaire for the Degree of Appreciation that is anchored on the Process Standards for Mathematics. This instrument quantifies the degree of appreciation of the students about the utilization of matrix concepts in cryptograms with respect to the enhancement of certain skills embedded in the process standards. It is a fourteen-item questionnaire categorized into four indicators. The first two indicators are Problem Solving Skill Enhancement and Mathematical Communication Enhancement, each having four sub-indicators. The last two indicators are Mathematical Connection with Reasoning Enhancement, and Mathematical Representation Enhancement, each composed of three sub-indicators.

In order to determine the students` degree of appreciation for these variables, the researcher used a 5-point Likert for the instrument which measures and provides rating as follows: 5-Strongly Appreciated, 4-Appreciated, 3-Somewhat Appreciated, 2-Least Appreciated, and 1-Not Appreciated. In particular, the degree of appreciation was assessed considering the following range of means: 4.20-5.00 (Very High), 3.40-4.19 (High), 2.60-3.39 (Moderate), 1.80-2.59 (Low), and 1.00-1.79 (Very Low), which were correspondingly interpreted as that the utility to enhance the described math skill is always recognized by the student to never recognized at all.

The second set of questionnaire was designed to measure the performance of the students in invertible matrices. The questionnaire was composed of 14 items for matrix operations and cryptogram exercises. Items 1-10 (2 points each) was on Multiplication and determination of matrices, and items 11-14 (5 points each) was to test the skill of the respondents in encoding and decoding of message in cryptogram.

The level of performance in invertible matrices was assessed through a questionnaire consisting of items on the determination of product and inverse of matrix. Each part of the examination tool was given maximum points of 20 for a total score of 40, which consequently were categorized as follows: 33-40/17-20 (Very High), 25-32/13-16 (High), 17-24/9-12 (Average), 9-16/5-8 (Low), and 1-8/1-4 (Very Low), to describe the level of performance of the students. Correspondingly, these were interpreted as that the students' performance is excellent, very good, good, fair, poor, and very poor.

In data gathering, 4-5 sessions for one hour per session were spent to teach the students using a learning module for matrix multiplication, determination of the inverse of matrix and cryptogram, specifically encoding and decoding of message using a coding matrix. Then the two sets of questionnaires were administered for additional of 1-2 sessions for one hour per session. The gathered data were tabulated, then statistically analyzed using mean to determine the respondents' degree of appreciation of utilization of matrix concepts in cryptogram and level of performance in invertible matrices, and Pearson product moment correlation to determine the significance of relationship between the two variables.

RESULTS AND DISCUSSION

Degree of appreciation of the utilization of matrix

Table 1. Degree of appreciation on the utilization of matrix concepts in cryptograms

Items	Mean	Descriptive Rating
Problem Solving Skill		
1. applies a variety of appropriate strategies to solve problems	3.86	High
2. solves problems that arise in mathematics and those involving mathematics in other contexts	3.86	High
3. builds new mathematical knowledge through problem solving	4.00	High
4. monitors and reflects on the process of mathematical problem solving	3.93	High
Mean	3.91	High
Mathematical Communication		
1. communicates his/her mathematical thinking coherently and clearly to peers, faculty, and others	3.57	High
2. uses the language of mathematics to express ideas precisely	3.50	High
3. organizes mathematical thinking through communication	3.79	High
4. analyzes and evaluates the mathematical thinking and strategies of other	3.71	High
Mean	3.64	High
Mathematical Connections with Reasoning		
1. recognizes and uses connections among mathematical ideas	3.79	High
2. recognizes and applies mathematics in contexts outside of mathematics	3.50	High
3. demonstrates how mathematical ideas interconnect and builds on one another to produce a coherent whole	4.00	High
Mean	3.76	High
Mathematical Representation		
1. uses representations to model and interpret physical, social, and mathematical phenomena	3.43	High
2. creates and uses representations to organize, record and communicate mathematical ideas	3.86	High
3. selects, applies and translates among mathematical representations to solve problems	3.79	High
Mean	3.69	High
Overall	3.75	High

As shown in table 1, the students' degree of appreciation on the utilization of matrix concepts in cryptogram that is anchored on the process standards for mathematics has an overall mean of 3.75 which has a descriptive rating of high. Consistently, all indicators show high degrees of appreciation, which indicates that the Discrete Mathematics students often recognize the power of the utilization of matrix concepts in cryptogram to enhance the various aspects of mathematics learning, especially on the products and inverses of matrices, as stipulated by the NCTM Process Standards for Mathematics.

The results of this study agree with the author's previous findings that supplementary activities elevate the appreciation of math concepts and improve the analytical skills of the students regardless of their learning styles. Moreover, the results of this study confirm what is described by the NCTM process standards for mathematics which stipulates that the inclusion of essential components, such as problem solving, communication, connection with reasoning and representation, in mathematics pedagogy can provide a common foundation of mathematics to be learned by the students. The implementation of a well-prepared and well-supported framework may eventually lead to an advantage perspective of learning which promotes degree of appreciation of the subject matter. The outcomes of this present study also jibe with what was reported by the National Council of Educational Research and Training (2006) that students should learn to enjoy mathematics - the same idea reflected by the NCTM process standards, which is to highlight the mathematical processes that students draw on to acquire and use their mathematical content knowledge (NCTM, 2000).

Problem Solving Skill. The students' problem solving skill is high (M = 3.91), which means that they often recognize the power of the utilization of matrix concepts in cryptogram to enhance their performance in product and inverse of the matrix determinations. This result indicates that the students apply a variety of techniques to solve problems that arise in mathematics, create new knowledge through problem solving, and monitor and reflect on the process of mathematical problem solving. Thus, students appreciate applying a variety of appropriate strategies based on reference, information provided, recalled, or developed. The results indicate that students would normally require frequent opportunities to formulate and provide solutions to complex problems.

Although all of the items are rated high, it can be seen from table 1 that specifically, the students have exhibited relatively higher skills on building new mathematical knowledge through their explorations in problem solving (M=4.00) giving them opportunities to monitor and reflect on the process of problem solving (M=3.93). These specific outcomes jibe with what Cobb et al. (1991) reported that teachers providing just enough information to establish background/intent of the problem, and students clarifying, interpreting, and attempting to construct one or more solution processes can direct students to their creation of new knowledge and skills.

Also, as a corollary, these results confirmed Schoenfeld's (1994) ideas that a good problem should be one which can be extended to lead to mathematical explorations and generalizations illustrating the three characteristics of mathematical thinking, namely, valuing the processes of mathematization and abstraction and having the predilection to apply them; developing competence

with the tools of the trade and using those tools in the service of the goal of understanding structure – mathematical sense-making. Cobb et al. (1991) also stressed that the purpose for engaging in problem solving is not just to solve specific problems, but to 'encourage the interiorization and reorganization of the involved schemes as a result of the activity.' This supports NCTM stand that teachers should utilize vehicles for students to construct, evaluate and refine their own theories about mathematics and the theories of others. This would nourish learners' confidence in their own ability to think mathematically.

Mathematical Communication. The students' mathematical communication is also high (M=3.64), which means that they often recognize the power of the utilization of matrix concepts in cryptogram to enhance their performance in product and inverse of the matrix determinations. These are characterized by communicating their mathematical thinking coherently and clearly to the people they interact with at school, using language of mathematics to express ideas precisely, and consequently, organizing, analyzing, and evaluating the mathematical thinking and strategies of their teachers and classmates as well. Particularly, data from Table 1 show that the students manifest relatively more the ability to organize their mathematical thinking through communications (M=3.79). This specific outcome validates Bandura's Social Learning Theory which stresses the importance of observational learning, imitation and modeling. His theory integrates a continuous interaction between behaviors, personal factors - including cognition – and the environment. The influence of behavior, environment and person depends on which factor is strongest at any particular moment. This was manifested by the students who participated in this study.

This finding agrees with those reported by Oshkosh (2008) which stipulates that mathematical communication must be required from the students if only to facilitate the construction and sharing of mathematical meaning and promote student reflection on the nature of the mathematical meanings they are required to communicate. The result also concurs with the NCTM process standards which uphold the idea of having a dynamic view of the classroom environment. This framework demands a context in which students are actively engaged in developing mathematical knowledge by exploring, discussing, describing, and demonstrating (NCTM, 2000).

Mathematical Connection and Reasoning. The students' degree of mathematical connection and reasoning is also high (M=3.76). This result describes that the student respondents often recognize the power of the utilization of matrix concepts in cryptogram to enhance their performance in product and inverse of the matrix determinations, as manifested by recognizing and establishing connections among mathematical ideas, applying mathematics in contexts outside of mathematics, such as in physical sciences, engineering, social sciences and business, and demonstrating how mathematical ideas interconnect and build on one another to produce a coherent whole. Based on the gathered data, the student respondents showed skills to reason and think analytically by noting patterns, structure, or regularities in both real-world and mathematical situations.

Specifically, the item which says that the students demonstrate how mathematical ideas interconnect and build on one another to produce a coherent whole, has the relatively higher mean (M=4.00). This particular outcome concurs with what was reported in the article of Herringer (2013) which states that "Children are naturally curious and learn to make sense of their world through exploration, questioning and reasoning." Thus, through reasoning, students connect ideas, gain a deeper conceptual understanding and ultimately enjoyment of mathematics. In short, it is through reasoning that they learn that mathematics makes sense. Currently, math curricula around the world emphasize the process of reasoning as one of the key mathematical practices (Herringer, 2013).

The result of this study agrees with the stipulations of NCTM (2000) process standards which uphold the notion that it is natural for students to form conjectures on the basis of the examples they have seen or worked and to develop arguments that are based on what they know to be true. Thus, all students should have explicit opportunities to engage in such intuitive, informal reasoning and, hence, any assessment of students' reasoning abilities should obtain evidence of these processes.

Mathematical Representation. The students' degree of mathematical representation was also revealed to be high (M=3.69), which indicates that they often recognize the power of the utilization of matrix concepts in cryptogram to enhance their performance in product and inverse of the matrix determinations. Based on the gathered data, the students appreciate using representations to interpret physical, social, and mathematical phenomena. As revealed by the items with the relatively higher means, the learners often create and use symbols to organize, record and communicate their mathematical ideas (M=3.86) as well as select, apply, and translate among these representations to solve problems (M=3.79).

These results agree with what was stipulated by the NCTM (2000) which reports that representations are useful in all areas of mathematics because they help develop, share, and preserve mathematical thoughts. Representations help to portray, clarify, or extend a mathematical idea by focusing on its essential

features" (NCTM, 2000). Mathematical representation refers to the wide variety of ways to capture an abstract mathematical concept or relationship. A mathematical representation may be visible, such as a number sentence, a display of manipulative materials, or a graph, but it may also be an internal way of seeing and thinking about a mathematical idea. Regardless of their form, representations can enhance students' communication, reasoning, and problem-solving abilities; help them make connections among ideas; and aid them in learning new concepts and procedures. These were manifested by the learners in this study.

This finding further concurs with the results of the authors' previous study (Limjuco, 2013) creative pedagogy enrich learners' math appreciation. In this present study, cryptogram representations provided opportunity for students to engage in mathematical operations in creative ways, hence increase attention, understanding, and also their confidence in mathematics.

Level of performance in invertible matrices

Table 2. Level of performance in invertible matrices

Areas	Mean	Descriptive Rating
Product and Inverse of Matrix	9.89	Average
Encoding/Decoding	18.04	Very High
Overall	27.93	High

Table 2 shows the level of performance of the students in matrix operations involving the invertible matrices. The overall performance is high at a mean of 27.93. This indicates that the students' performance is very good. This result depicts the mathematics students to have adept performance by being able to score 70% in the test. This result indicates that most of the respondents were able to answer correctly around 8 out of 14 items.

Product and Inverse of Matrix. The determination of product and inverse of the matrix involved the multiplication of two square matrices to verify whether one is the inverse of the other depending on the resulting matrix, that is, an identity matrix results if the first one is invertible. As shown in table 2, the performance of the students in determination of product and inverse of matrix is average with a mean of 9.89. This describes that the students' performance is good. This indicates that the mathematics students have shown good performance by being able to score 50% in the subtest. This describes that almost half of the items in the first part of the test was answered correctly by the majority of the respondents.

Encoding and Decoding. Coding and encoding items require the students to multiply a given matrix X carrying the message to a coding matrix A (AX = B), and then, to multiply the resulting product to the inverse of the coding matrix (A-1B = X) to retrieve the original message. Table 2 shows that the level of performance of students in encoding and decoding is very high with a mean of 18.04. This indicates that the students' performance is excellent. This describes that the mathematics students have shown excellent performance by being able to score 90% in the subtest. It indicates that almost every item on encoding and decoding were answered correctly by the student respondents.

Relationship between the degree of appreciation and the level of performance

Table 3. Test for the significance of the relationship between degree of appreciation and performance in invertible matrices

Degree of Appreciation	Performance in Invertible Matrices	Pearson R	p-value	Decision @ α = .05
Problem Solving Skill	Product and Multiplicative Inverse	.573	.032	s
	Encoding/Decoding	.117	.691	ns
	Overall	.396	.161	ns
Mathematical Communication	Product and Multiplicative Inverse	.554	.040	s
	Encoding/Decoding	.103	.727	ns
	Overall	.390	.168	ns
Mathematical Connections with Reasoning	Product and Multiplicative Inverse	.284	.326	ns
	Encoding/Decoding	.072	.807	ns
	Overall	.267	.357	ns
Mathematical Representation	Product and Multiplicative Inverse	.480	.082	s
	Encoding/Decoding	.184	.530	ns
	Overall	.370	.193	ns
Overall	Product and Multiplicative Inverse	.559	.038	s
	Encoding/Decoding	.139	.634	ns
	Overall	.418	.137	ns

s = significant, ns = not significant

To ascertain whether the degree of appreciation of the students on the utilization of matrix concepts in cryptogram is significantly related to the level of performance in invertible matrix, the Pearson r value was calculated not only for the overall means of the two variables but also for the other indicators of each. The significance was determined through an alpha value of .05.

As shown in table 3, overall, there is no significant relationship between the degree of appreciation on the utilization of matrix concepts on cryptogram and the level of performance in matrix operations involving product and inverse of matrices (r = .418; p-value = .137). Thus, whether or not the students have appreciation on the various process standards in mathematics as applied to the utilization of matrix concepts in cryptogram, it does not bring about significant linear correlation with the performance of the students in invertible matrix.

Nevertheless, a closer examination of the other indicators paired with one another has revealed significant relationships, namely, problem solving skill and product/multiplicative inverse (r = .573; p-value = .032); mathematical communication and product/multiplicative inverse (r = .554; p-value = .040), and the overall degree of appreciation and /multiplicative inverse (r = .559; p-value = .038). These results show that the more efforts the students invest on using problem solving strategies such as diagramming, guessing and checking, pattern finding, table forming and working backwards, the more likely that they will achieve better performance. Also, the more these learners interact with their teachers, peers and other classmates for consolidated thinking, the more that they get better results for their performance in invertible matrices. Consequently, the more appreciative the students are of the utilization of matrix concepts in cryptogram, as anchored on the process standards for mathematics, the more likely they would perform better in matrix operations involving inverse of matrices.

These results jibe with the previous findings of the author that the appreciation of mathematics is heightened by seeing the concrete applications of the concepts to real-life situations. The results also jibe with the study done by Mann (2005) which established significant relationship of mathematical creativity to mathematical achievement, attitude towards mathematics, self-perception of creative ability, and teacher perception of mathematical talent. Thus, a learner's growth in mathematics involves more than just mastering computational skills. Mathematical talent is not defined by computational speed alone but also creative approaches in the exploration and solving of mathematical problems.

Conclusions. The math students often recognize the power of the utilization of matrix concepts in cryptogram to enhance the various aspects of mathematics learning, especially on the products and inverses of matrices, as stipulated by the National Council of Teachers of Mathematics Process Standards for Mathematics. In general, they show adept performance in invertible matrices although would experience confusion initially in the determination of product and inverse of the matrix. Eventually, the performance will be enhanced if the matrix concepts are embedded in concrete process that is meant to be used to a real life situation. Whether or not the students have appreciation on the various process standards in mathematics as applied to the utilization of matrix concepts in cryptogram, it does not bring about significant relationship with the performance of the students in invertible matrices. However, specific domains of process standards in mathematics gauged for the degree of appreciation established significant relationships with certain matrix operations.

Recommendations. On the basis of the data gathered and the derived conclusions, it is recommended that a more dynamic classroom situation filled with strategies based on the process standards of NTCM be implemented. The utilization of matrix concepts in cryptogram can encourage the appreciation of mathematics especially the lessons in matrices; therefore, it may be introduced in the classroom. Also, creative approaches may be introduced in the teaching of matrix operations especially in product and inverse of matrix determinations. It is suggested to incorporate the use of problem solving strategies, such as diagramming and pattern generalizing. The integration of concepts of encryption and cryptogram may be used to teach effectively the concepts of inverse of the matrix. It is encouraged to establish a learning environment that can promote

degree of appreciation of mathematics in the instruction, especially by anchoring it on process standards, such as problem solving skills, communications, connections with reasoning, and representation. This would improve learners' performance in Mathematics.

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International Journal of Education Research for Higher Learning *Print ISSN 1656-0604*
Vol. 22 No. 2 October 2016 *Online ISSN 2244-6532*

Integrating Art and Science in Teaching Mathematics: Its Effect to the Mathematics Performance of Selected First Year College Students

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ABSTRACT

The purpose of this study was to investigate the effectiveness of art and science integration on selected first year Bachelor of Science in Accountancy students' mathematics performance at the University of the Immaculate Conception. The performance of the students was based upon their pretest and posttest scores on the researcher-made instruments. The sample included 73 Accountancy freshmen students. Using gain score analysis (GSA) and causal-comparative research design, the researchers analyzed the pretest and postest scores. One group of students received instruction through a traditional teaching method and a second group received instruction through an art and science integrated method. By analyzing the data using ANOVA, the results indicated that the teaching method had no significant effect in their performance. The study looked closely at the differences in achievement between the two methods for different student intelligences and the results indicated that there were no significant differences in the gain scores. This study indicates that the arts and science integration in mathematics teaching has the potential of enhancing the mathematical performance of students. However, there are conditions that need to be met in order to facilitate better transfer of learning.

KEYWORDS: Mathematics, art and science, teaching math, math performance, Philippines

INTRODUCTION

Mathematics is important and has a strong position in all fields of science and technology due to the fact that it is learned from childhood to adulthood. However, an adult's lack of mathematical knowledge and skill could not make him progress in life since it is required on his day to day life (Xavier, 2013).

According to Firestone (2013) nearly 90% of high school graduates say they are not interested in a career or a college major involving engineering or mathematics. He said that the reason behind was the lack of interest and students have been turned off from the math subjects as they move from kindergarten to high school since teachers taught them without particular expertise in the subjects. As a result, he added that the student became convinced they are no good at math, and math are only for nerds and fall behind. He also stated that mathematics today is viewed as a difficult, boring and dull subject.

To provide a better education for the students' math performance, Science, Art and Mathematics can be integrated to explore knowledge common to the disciplines (Mathematics University of Copenhagen, 2010). Science involves math where it applies geometric principles such as symmetry, reflection, shapes, algebraic balance, growth ratios and genetic matrices (Leimberer, 2011). Science and Mathematics interact where math is used to analyze nature, discover secrets and explain its existence, likewise where science require mathematical tools to study, analyze and interpret experiments (Bieler, 2011). When a teacher gives students a real science problem to solve – one that requires math tools – the teacher is giving the students a reason to use math towards their learning (O'Hair & Dennis, 2011), hence Math becomes useful not to be dreaded.

On the other hand, Arts can be integrated in math subjects where it expresses students' performance in math through artistic process and because it raises the level of students' engagement that addresses relevance of learning. Arts helps students to explore connections between concepts and big ideas, providing a stimulating learning experience for individuals (PAEP Teachers Workshop for Middle Ages, 2005).

Through a workshop program that shows Middle School teachers why and how to integrate arts and science in math subjects, the Philadelphia Arts in Education Partnership (PAEP) has shown that arts and science integration provides a stimulating learning experience for individual teachers and the development of learners (PAEP, 2014).

However, the integration is not easy in some circumstances, like teachers have independent instruction, and strategies for planning the lessons to integrate needs

refinement and expertise (Lavine Production Group, Inc., 2005). Unfortunately, knowing that increased teacher integration in Math, Art and Science will benefit students and teachers is not enough for the reason that, teachers are so busy, that finding time to collaborate is difficult and it needs a long preparation time for the integration matter (Johnon, 2011). Ronda (2004) in his column in the Philippine Star revealed that 98% of high school students fail to get 75% in the 2004 National Achievement Test.

These circumstances highlight the need to make changes in the teaching to develop students' mathematics performance and lifelong learning skills (Wang, 2005). This current study investigated the effectiveness of art and science integration in teaching mathematics, by anchoring on the constructivist learning theory of Piaget.

The constructivist learning theory states that the learners have a natural curiosity to construct meaning of the world around them by exploring their environment and constructing knowledge from these experiences. It was generally accepted that the best learning takes place when a number of senses were stimulated. The integration of art and science in teaching math would stimulate the greatest number of senses. The effectiveness was based on the organization of the knowledge delivery system as well as the mode of delivery, these would display a positive effect on the cognitive level of the students specifically their mathematics performance (Jonassen, 1990).

Study Objectives. With the current educational problem in mathematics, the improvement of the academic performance of students in math becomes critical. One of the solutions and steps towards improving students' academic performance in Mathematics is the teaching strategy using the art and science integration in math instruction. It is in this context that the researcher wants to determine the effectiveness of integrating art and science in math instruction to students' mathematics performance. Specifically, the mean gain scores of two groups (Experimental and Control groups) of University of the Immaculate Conception (UIC) Bachelor of Science in Accountancy (BS Accountancy) freshmen students in pretest-posttest questionnaire were compared and analyzed by Analysis of Variance (ANOVA).

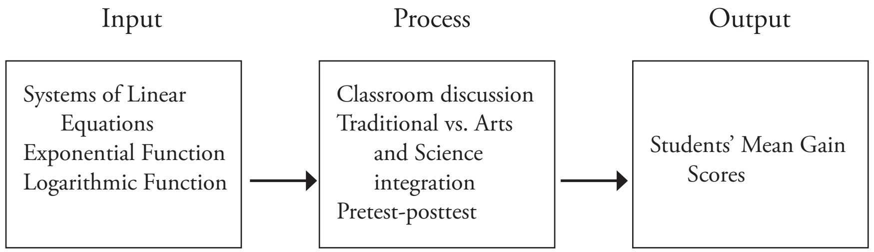

Figure 1. The conceptual framework of the study

In this study, the input-process-output conceptual framework was utilized. The mathematical concepts that served as inputs in this study are the systems of linear equations, exponential and logarithmic functions. The process involved classroom discussions of these concepts by traditional method versus the approach of arts and science integration, as well as written tests before and after the discussions. The students' mean gain scores served as the output in the study. The aim was to find out whether the integration of Arts and Science in teaching math particularly on topics related to linear equations, exponential and logarithmic functions could significantly improve the performance of the respondents.

METHOD

The researchers used quasi-experimental design with two groups, control group and experimental group, and pre-test and post-test comparison. A quasi-experimental design was used since it is appropriate to determine whether an intervention has the intended effect on studied respondents.

Two sections with a total of seventy-three first year students from the Bachelor of Science in Accountancy students of the University of the Immaculate Conception during the first semester of academic year 2014-2015 comprised the respondents of the study. The respondents were chosen granted that they were having their College Algebra subject and they also have many Math subjects in their particular course. The respondents were also fit for the study for the reason that they were dealing with art and science as they were having their finance graphing in their Business subjects.

The study was conducted at UIC College Department, particularly in the

Annex Campus, Bonifacio Street, Davao City. UIC is the oldest private school in Davao City, founded by the Religious Virgin Mary (RVM) congregation in 1905. UIC is home to 10 programs one of which is the Accountancy and Business Administration (ABA) program where the students of the study belonged. The 73 freshmen students from the ABA program were purposively chosen since their and the researchers' schedule matched with period when the study was conducted. Prior approval of the ABA program dean to conduct the study was secured.

The research instrument was an expert-validated researcher-made questionnaire that contains three topics namely systems of linear equations, exponential function, and logarithmic function, and with attached informed consent. After a 25-item pilot-testing for test reliability, the researchers item-analyzed the data and retained 20 items which were then checked for internal consistency by subjecting to Kuder-Richardson reliability testing, which revealed 73% reliability of the final researcher-made questionnaire. The validated and reliability-tested questionnaire was then used in the pretest of the two groups of respondents.

After which, the researchers conducted a teaching process utilizing two approachaes – with art and science integration for the experimental group and the traditional or without art and science integration for the control group of the respondents. The class under art and science integration was provided with learning guide. Some activities done were the use of paintings that enabled the respondents to get the equation of the line out of the lines and curved lines on the provided paintings. Another activity was the Scalding "Hot Coffee or Adding a Timer Video" which allowed the respondents to plot a graph about the temperature of the coffee and the time they met. By these activities, art and science were integrated in teaching maths without the awareness of the students that it was part of a teaching approach experimentation, which lasted within nine meetings for both groups. Afterwards, the students answered the post-test questionnaire.

The gathered data were then tabulated and statistically analyzed using ANOVA of gain scores adapted to Dr. Lee Becker's Effect size calculator for the traditional versus art and science integration approach, to determine existence of significant difference between the mean gain scores of the control group and the experimental group post-test scores.The improvement (mean gain score) from pretest to posttest was computed for each respondent by subtracting each person's pretest score from his or her posttest score (i.e., Gain = Posttest Score – Pretest Score).

RESULTS AND DISCUSSION

Comparison of mean gain scores of control and experimental groups

Groups	Average Mean Gain	Description
Experimental	.85	positive
Control	.90	positive

The results show that the average mean gain scores for both groups are positive. This means that the average posttest score was greater than the average pretest score in both groups, indicating a gain in the score at posttest.

The dependent variable of this study was the level of performance so we expect that successful teaching strategy would lead to higher performance. The results show very close average mean gain scores of both groups with only 0.05 difference. Thus, it is safe to say that both teaching approaches improved the students' performance. However, it is not safer to say that the experimentation or art integration significantly improved the level of mathematics performance since both groups were improved.

The results of the current study imply that the technique used in integrating arts and science in teaching mathematics did not really give a great impact to raise the level of performance of the students and to encourage them more that learning mathematics is fun. The research failed to support the theoretical framework quoted with Jean Piaget's learning theory of constructivism. The research had just failed to supply or to exert the fullest effort to demonstrate well the integration.

Nevertheless, the results of the study open bigger challenges for math teachers to improve art and science integration in math teaching, or find other creative ways in doing so, and testing their effectiveness in groups of learners. While the fact remains that many students are unexcited with mathematics, the challenge for math teachers to inspire and encourage students to learn the subject also remain.

Further, the results supported the study that the integration is not easy in some circumstances, like teachers have independent instruction, and strategies for planning the lessons to integrate needs refinement and expertise (Lavine Production Group, Inc., 2005). Unfortunately, knowing that increased teacher integration in Math, Art and Science will benefit students and teachers is not enough for the reason that, teachers are so busy, that finding time to collaborate is difficult and it needs a long preparation time for the integration matter (Johnson,

2011). Indeed, unprepared teachers will not be convincing in any teaching activity. The teachers themselves should somehow show to students some level of passion for arts if they are to integrate arts in teaching math. Hence, the teachers should research on the artworks and come prepared with stories relating to the artworks and the artists to be more convincing.

Other factors like the time of intervention, teacher and student personality, and student learning style should be considered in choosing the kind of art and science integration in teaching math.

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International Journal of Education Research for Higher Learning *Print ISSN 1656-0604*
Vol. 22 No. 2 October 2016 *Online ISSN 2244-6532*

The Effect of Using Web 2.0 Technology in Learning Mathematics to the Mathematics Anxiety of the First Year Education Students of the University of the Immaculate Conception

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ABSTRACT

The number of re-enrollees in Math 1 and the low number of students pursuing a course major in mathematics prompted the researcher to explore the use of Web 2.0 technologies in lowering the mathematics anxiety of the students. Even though mathematics is part of the daily lives of the people it is a fact that students enrolled in universities and colleges who were taking mathematics feel the tensions referred as mathematics anxiety. Matlab were one of the Web 2.0 technologies in mathematics used by the researchers. In this study, thirty-nine (39) education students were involved and explored the use of Web 2.0 technologies in their math subject. Results showed that among the three (3) factors: physical and emotional factor, assessment factor, and social factor, only the assessment factor showed a positive result. The physical and the social factors showed an insignificant result. Further, no significance of relationship was found between math anxiety and the level of use of Web 2.0 technologies.

KEYWORDS: Mathematics, Web 2.0 technology, anxiety, Davao City, Philippines

INTRODUCTION

Math is present in everything that people do. In school, however, students poorly perform in Math due to anxiety or fear of performing mathematical problems. Ashcraft (2002) referred mathematics anxiety as the feeling of tension, apprehension and fear that interferes with mathematics performance and students deal with this anxiety through avoidance (Chinn, 2012). Anxious math students will avoid situations in which they have to perform mathematical calculations and math avoidance results in less competency, exposure and math practice, leaving students more anxious and mathematically unprepared. In college and university, anxious math students take fewer math courses and tend to feel negative towards math (Ashcraft, 2002).

In the study of Shields (2006), 45% developed and experienced math anxiety and when students enter college and take up introductory math courses, 85% of the students feel at least mild math anxiety (Pierce and Ball, 2009). In the Philippines, Cabahug and Ladot (2005) said that it is also common among students in State University to repeat mathematics courses and a declining performance in basic math. Bilbase (2010) said that classroom setting and teaching style contributed to the students' math anxiety.

Technology is introduced as a tool for learning mathematics. This helps in developing students' understanding and opens their interest and brings out their potentials (NCTM, 2010). Further, Web 2.0 technologies are a set of technology trends which uses internet as a medium. One of the examples of Web 2.0 technology in mathematics is the Matlab. Matlab is an interactive tool used for numerical computation and visualization. According to Hart (2014), these technologies opens opportunity and gives an easy access in learning through exchanging of resources and ideas; asking and answering questions; and building a personal or even professional connections with others, and they are used as an assistant in reducing math anxiety.

According to the constructivist learning theory of Piaget learners are required to explore their environment and construct their own knowledge through their experience. He viewed that through technologies such as computers and other multimedia, the solving skills of the students will be enhanced and anxiety will lessen. Using Web 2.0 technology, students' anxiety in math will be diverted through the interaction among users and making math more enjoyable. Several students are forced to re-enroll Math 1 and only few education students' majors in Mathematics, thus, this study would like to explore the possibility that using Web 2.0 technologies it will help reduce re-enrollment in Math 1 and hopefully inspire students to take major in Math.

Conceptual Framework

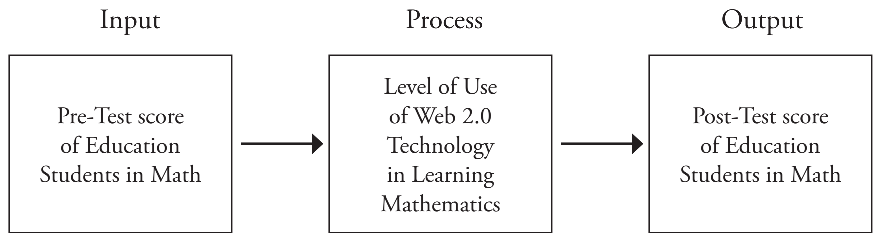

Figure1. Conceptual framework

As shown in Figure 1, the level of use of Web 2.0 technologies in learning mathematics was conceived to have a significant role in reducing the mathematics anxiety level of the education students. Thus, the pre-test score will serve as the baseline anxiety level prior to the intervention class with the use of Web 2.0 technologies and post-test score will represent the math anxiety level of the students after the intervention.

Objectives of the Study

This study explored the influence of Web 2.0 technology usage to the math anxiety of the students. Further, it sought the significant difference between the level of math anxiety of the students before and after the intervention.

METHOD

This study is a quantitative research and primarily it utilized experimental design specifically one group pre-test, post-test. Incidentally, this study is also correlational because it attempted to establish whether there is a significant relationship between the use of Web 2.0 technologies and the math anxiety of the first year education students of the University of the Immaculate Conception during the first semester of school year 2014-2015.

This study was conducted at the University of the Immaculate Conception, a private Roman Catholic university run by the Religious of the Virgin Mary

(RVM) in Davao City. Specifically, the study was conducted in the college department of UIC, Bonifacio Street, Davao City. The University of the Immaculate Conception accommodates 9 programs that offer 21 different courses.

The respondents are the freshmen education students who were enrolled in math 1 subject during the first semester school year 2014-2015. Respectively, there were 3 groups: the respondents in section A, B, and C were each are provide of three different lessons.

The study utilized two sets questionnaires: the first set included 14-item researcher-made questionnaire which gauged the level of usage of Web 2.0 technology of the students. The second set facilitated the determination of the anxiety level of the respondents in relation to their mathematics subject has three indicators– physical and emotional factor, assessment factor, and social factor. It is a thirty (30) item, 5-point Likert scale questionnaire taken from Mathipedia created by Roberts (2011).

During the data gathering a letter of permission to conduct the study was sent to the UIC Dean of Education Program and to the computer laboratory in-charge. The math teachers of the freshmen students were also notified about the purpose of the conduct the study. When all preparations were set, class visitation took place to inform students about the study and the necessity to use the computer laboratory. At the start, the researchers administered a pre-test to the students. Afterwards, the researchers taught a lesson using the Web 2.0 technologies. After the lesson, the post-test was administered. After which, another questionnaire was administered to the respondents to measure their level of Web 2.0 usage. After the respondents completed the questionnaires, the researcher retrieved the questionnaire, tabulated and analyzed the data using t-test for dependent means (compares the mean difference between sample scores) and pearson-product moment correlation coefficient (r) (determines the degree of linear relations between two variables). Below is the matrix of interpretation:

Level of Math Anxiety

Mean	Descriptive Level	Interpretation
4.50-5.00	Very high	This means that the math anxiety of the respondents are manifested at all times.
3.50-4.49	High	This means that the math anxiety of the respondents are manifested oftentimes.
2.50-3.49	Moderate	This means that the math anxiety of the respondents are manifested sometimes.
1.50-2.49	Low	This means that the math anxiety of the respondents are rarely manifested.

RESULTS AND DISCUSSION

The use of Web 2.0 technology in the classroom changed the mood of the students. It provided a friendly atmosphere making the students less anxious.

Table 1 shows the level of math anxiety of the first year education students during pretest (2.91) and described as moderate. This implies that the math anxiety of the students during pretest is manifested sometimes. Specifically, the physical factor (2.60), assessment factor (3.40) and social factor (2.74) as moderate. This means that the Math anxiety of the first year education is sometimes manifested.

Table 1. Level of math anxiety prior to the intervention

Math Anxiety	Mean	Descriptive Equivalent
Physical factor	2.60	Moderate
Assessment Factor	3.40	Moderate
Social Factor	2.74	Moderate
Overall Mean	2.91	Moderate

Table 2 displays the level of math anxiety of the first year education students after posttest (2.83) which signifies a moderate level. This means that the math anxiety of the students still manifest despite of the intervention. This further implies that a single intervention will not be able to address the math-related anxieties. It can be noted that the Math anxiety of the respondents with regards to the physical factor is low (2.47) which means that the math anxiety of the students is rarely manifested. As to the assessment and social factors, the mean levels of 3.27 and 2.75 respectively, indicate that the math anxiety of the students is sometimes manifested.

Table 2. Level of math anxiety after the intervention

Math Anxiety	Mean	Descriptive Equivalent
Physical factor	2.47	Low
Assessment Factor	3.26	Moderate
Social Factor	2.75	Moderate
Overall Mean	2.83	Moderate

Data in table 3 shows the level of use of the respondents which is low (2.35). This means that the respondents do not post answers to Math-related assignments in their facebook account (1.40), they do not also use Geogebra in making their assignments (2.06), they also do not utilize Facebook to discuss assignments with their classmates (2.38), and they do not access yummy website (1.98). This implies that socially they do not like to talk about math online, they still have limited knowledge as to the extent of the use of Web 2.0 technology in helping them solve math problems in school.

However, it is noteworthy to stress that the respondents prefer to answer computer-based homework as they find it interesting (3.08). Likewise, respondents also find youtube- based educational videos helpful in learning math concepts (2.54), slideshare as important sources of learning materials (2.54) and math online games as facilitative in learning math (2.64). This result suggests that it could be more interesting to learn math through computer-based resources such as games, video clips, PDFs and Powerpoint presentations.

Table 3. Level of use of Web 2.0 by the respondents

Statement	Mean	Descriptive Equiv.
1. using Web 2.0 technology such as blog, Facebook, podcast, twitter, wikis and others in learning math.	2.94	Moderate
2. preferring computer-based math homework because it is more interesting than paper-pencil math homework.	3.08	Moderate
3. using mathematics applications such as Geogebra in doing my homework.	2.06	Low
4. asking help or suggestions on homework from Wikis.	2.62	Moderate
5. answering online math exercises.	2.08	Low
6. utilizing Facebook to do an online discussion of assignments with my classmates.	2.38	Low
7. using Web 2.0 technologies to enhance my Math competency.	2.30	Low
8. posting my answer on Facebook to have a feedback from my classmates.	1.40	Very Low
9. watching educational videos in Youtube to help me understand math even more.	2.54	Moderate
10. using Web 2.0 technologies to accomplish math tasks more quickly.	2.40	Low
11. participating in an online discussion about Math.	1.92	Low
12. accessing Slideshare to get specific information about Math in a form of PowerPoint or PDF.	2.54	Moderate
13. accessing Yummy math website which gives real world scenarios or challenges involving Math.	1.98	Low
14. looking for Math games online to develop my math skills.	2.64	Moderate
Mean	2.35	Low

Table 4 presents signifies that no significance of difference (0.096) exists between the level of math anxiety of the respondents based on their pretest and posttest scores. This result means that the use of Web 2.0 technology did not significantly reduce their anxiety; however, an improvement has been established as regard to the assessment factor (0.016). It means that they were able to gain confidence in taking quizzes or exercises after being presented with a particular topic in Math.

Table 4. Test for the significant difference in the level of math anxiety during pretest and posttest

Math Anxiety	Pretest	Posttest	Mean Difference	P-value	Decision (α=.05, 2-tailed)
Physical factor	2.60	2.47	0.13	0.134	Accepted
Assessment Factor	3.40	3.26	0.14	0.016	Rejected
Social Factor	2.74	2.75	-0.01	0.852	Accepted
Overall Mean	2.91	2.83	0.083	0.096	Accepted

Table 5 illustrates that no significance of relationship (0.188) exists between the level of math anxiety and the level of Web 2.0 usage of the first year education students prior to the intervention.

Table 5. Test for the significant relationship between math anxiety and use of Web 2.0 in their pretest (before the Intervention)

Independent Variable (x)	Dependent Variable Math Anxiety (y)	Pearson(r) value	P-value	Decision (α=.05, 2-tailed)
Use of Web 2.0	Physical factor	0.212	0.139	Not significant
	Assessment Factor	0.162	0.262	Not significant
	Social Factor	0.116	0.424	Not significant
	Overall	0.189	0.188	Not significant

Table 6 illustrates the significant relationship between the Math Anxiety and the Use of Web 2.0 of the students during the Posttest. The p-value of 0.159 implies that there is no significant relationship between the level of Math Anxiety and the level of Web 2.0 usage of the first year education students after the intervention. This result would mean that the study failed to establish the role of the Web 2.0 technology in addressing Math anxiety related issues. This could mean two things: the intervention which was facilitated for only two hours may not be enough or a more appropriate application (software) may be considered.

Table 6. Test for the significant relationship between math anxiety and use of Web 2.0 in their posttest (after the intervention)

Independent Variable (x)	Math Anxiety (y)	Pearson(r) value	p-Value	Decision (α=.05, 2-tailed)
Use of Web 2.0	Physical factor	0.174	0.227	Not significant
	Assessment Factor	0.145	0.315	Not significant
	Social Factor	0.227	0.113	Not significant
	Overall	0.202	0.159	Not significant

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International Journal of Education Research for Higher Learning *Print ISSN 1656-0604*
Vol. 22 No. 2 October 2016 *Online ISSN 2244-6532*

Perceived Acceptability and Difficulty of the Implementation of Senior High School - Science, Technology, Engineering and Mathematics Strand of Sorsogon State College

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ABSTRACT

The Department of Education implemented the Enhanced Basic Education Curriculum in 2013 which led to the creation of Senior High School (SHS) Program. Studies showed the importance of the support of stakeholders to the success of an educational reform. Thus, it is significant to consider the acceptance of the new curriculum. This descriptive- correlational and developmental study was designed to determine the acceptability of the SSC- SHS STEM Curriculum and correlate it to the difficulty level of problems along its implementation. Content- validated survey- questionnaires were used as the instrument. Statistical tools utilized were frequency count, ranking, percentage, mean and Pearson's coefficient of correlation. The null hypothesis was tested using non-directional t-test at 0. 05 level of significance. Findings showed that there was low acceptability of the new curriculum among stakeholders. It also revealed that the major problems along the implementation of the curriculum were on the areas of Facility and Instructional Materials, and that the difficulty level of the problems was high. Finally, it was found out that there was significant inverse correlation between the curriculum's acceptability level and the problems' difficulty level. Thus, the study concludes that the acceptability level of curriculum is significantly related to the difficulty level of the problems encountered by the school along its implementation. The researcher recommends that a series of information-dissemination programs be conducted to raise awareness on the significance of the STEM Curriculum among the stakeholders of the school. Interventions were also proposed to address the problems.

KEYWORDS: Acceptability level, difficulty level, perception, acceptance, problems, implementation, senior high school, STEM curriculum, program

INTRODUCTION

Republic Act 10533 otherwise known as the Enhanced Basic Education Act of 2013 mandates the Department of Education (DepEd) to create another level of the basic education composed of two years. These two additional years in the secondary level shall comprise the Senior High School (SHS) program as set by the aforementioned law (RA 10533, 2013). The primary goal of the program is to prepare secondary students to master the prerequisite skills needed in professional courses for those who will prefer academic tracks and to equip with employment and industrial skills needed for those who will prefer technical-vocational and other tracks (DepEd, 2013). Braza and Supapo (2014) mentioned that the new curriculum was the response of the government to the call of the educators for the standardization of the country's educational system to comply with international standards.

The Science, Technology, Engineering and Mathematics (STEM) track of the Philippine K to 12 – Enhanced Basic Education Curriculum is designed to produce graduates of secondary level who will take science, research, mathematics and engineering- related courses in tertiary level and thereby add to the scientific and scholarly workforce of the country (Philippine Basic Education, 2013). It can be noted that Magno (2010) said that a curriculum that is purposely designed for mathematics and science – inclined students could be the answer to a decade- long problem of low number of mathematics and science practitioners in the country. The low number of science professionals may be attributed to the poor academic performance of students in mathematics both in the elementary and secondary level. The study of Estonanto and Fungo (2014) pointed out that majority of secondary students are in the beginning level of mathematics proficiency. Moreover, Lee-Chua (2005) and Andaya (2014) cited out that Filipino learners have never been noted for excellent numerical ability. Thus, the implementation of the program could be an effective approach to address the problem.

Nevertheless, on the early stages of the implementation of the K to 12 curriculum, several oppositions to the program arose. Among the noted efforts to stop the new curriculum were the present cases in the Supreme Court to cite a few: Council for Teachers and Staff of Colleges and Universities of the Philippines et al. v. President of the Philippines et al., Antonio F. Trillanes IV et al. v. Executive Secretary et al., Richard Troy A. Colmenares, et al. v. DepEd Secretary et al., Ma. Dolores Brillantes et al. v. President of the Philippines, et al. and two others (SC, 2016). In the school level, administrators also struggle for

the acceptance of the program among its stakeholders especially to parents who still want the previous 4-year high school curriculum since the additional two more years would be another burden to them. This acceptance could have effect on the difficulty of the implementation of the program.

Having a laboratory high school established by virtue of R.A. 7666, the Sorsogon State College offers the SHS-STEM Program to qualified students who passed the admission policies of the institution (SSC Laboratory High School Academic Manual, 20119). In adherence to the mandate of R.A. 10533 and DepEd Order No. 43 s. 2013, the new curriculum was formally implemented starting June 2016. Since S.Y. 2016-2017 is the pioneer academic year of its implementation, a study on the acceptance of the program among the stakeholders of the school would be of great help to its implementers particularly to the front liners – the teachers. Studies showed the importance of the support of stakeholders to the success of an educational reform. Thus, it is significant to consider the acceptance of this new program. This study is about the acceptability of the Sorsogon State College SHS-STEM Program and the difficulty of its implementation. It is primarily concerned with the correlation between the two aforementioned variables.

Study Objectives. The main purpose of this study is to determine the perceived acceptability of Sorsogon State College SHS - STEM Curriculum and the difficulty of the problems encountered by the school along its implementation. Specifically, the study aimed to:(1) Determine the acceptability level of the SSC SHS-STEM curriculum among the following stakeholders- students, parents, faculty members and administrators; (2) Determine the difficulty level of the problems encountered along its implementation and the areas in the implementation that encountered major problems; (3) Test the relationship between the perceived acceptability and difficulty of the implementation of the curriculum and; (4) Propose intervention programs that will address the problems and thereby strengthen the implementation of the SHS-STEM curriculum.

METHOD

This study utilized the descriptive – correlational and developmental method of research. It is descriptive since it is concerned with determining the level of acceptability of the newly implemented curriculum and finding out the problems encountered along its implementation and the difficulty level of these problems. Likewise, it is correlational because it sought to test the relationship between the acceptability of the new program and the level of difficulty of the problems encountered. Finally, it is developmental since the findings were used as bases in developing intervention programs that would help solve the problems. It was primarily designed to determine the acceptability level of the SSC-STEM Curriculum and correlate it to the difficulty level of problems along its implementation. A content – validated survey – questionnaire was used as the primary instrument of this research. Statistical tools utilized were frequency count, ranking, percentage, mean and Pearson's coefficient of correlation.The null hypothesis was tested using non- directional t- test at 0. 05 level of significance.

Respondents of the Study. The researcher used Purposive Sampling in the determination of the respondents. The study involved 101 respondents which is the main subject of the research. Of which, 25 % of the supposed total number of students respondents and parents respondents were taken as sample who were identified through Simple Random Sampling or Fish Bowl Technique. Zulueta and Perez (2010) said that the minimum sample for smaller populations should not go lower than 20 % of the population which this study exceeded. Conversely, total enumeration for faculty member respondents and administrator respondents was considered in this study. Of these, 45 were students, 45 were parents, 6 were faculty members and 5 were administrators of the SHS program respectively.

Instrument Used. Researcher-made survey – questionnaires that were validated through Content Validity Method was utilized to determine the acceptability level of the curriculum, the areas of implementation that encountered major problems, and the difficulty level of the implementation of the program. Content Validity Test is a method of validating the test instrument with the help of critiques who are authorities in their own disciplines. Aquino (1997) stressed that a minimum of three instrument- evaluators may be required to maintain the credibility of the validation process. With this, three well-known graduate school professors in Sorsogon who are considered experts in the field of Curriculum Development and Implementation evaluated the content, practicality and efficiency of the instrument. Major revisions on the directions, content items and scoring were done based on the recommendations of these experts. Moreover, two dry-runs were also conducted prior to the actual release of the instrument to the respondents to secure both its validity and reliability. The instrument was found to be highly reliable with 0.90, 0.85, 0.89, 0.89, 0.90, 0.96 and 0.91 Cronbach alpha reliability scores for the Acceptability,

Curriculum, Faculty, Facility, Instructional Materials, Instruction and Learners respectively. Suggestions in the try-outs were considered in the finalization of the questionnaire.

The instrument was divided into two parts – Part I and Part II measure the acceptability level of the program and difficulty of its implementation correspondingly. For Part I, the following five- point Likert Scale was adopted in the instrument: 5-Very Much Agree, 4-Agree, 3-Moderately Agree, 2-Disagree and 1-Very Much Disagree (Salkind, 1997; Borromeo, 2013).

Likewise, the same five-point scale was utilized in the Part II of the instrument. However, it was modified to address the factors it was intended to measure. The scale was presented as follows: 5-Very Poor, 4-Poor, 3-Needs Improvement, 2-Good and 1-Very Good.

Interpretation of Data. In measuring the acceptability level, the following researcher- developed scale was used:

Acceptability Score	Acceptability Level
80-100	Very High
60-79	High
40-59	Low
20-39	Very Low

Furthermore, another scale was developed to measure the difficulty level of the problems encountered along the implementation of the curriculum. The researcher ensured that a four-scale model should be applied as well in this scale for practicality and for easy to use purposes. Therefore, the maximum points of 20 was applied in this study as follows:

Difficulty Score	Difficulty Level
20-25	Very High
15-19	High
10-14	Low
5-9	Very Low

Statistical Analysis. Frequency count and percentage were used in this study in determining the acceptability level of each stakeholder as categorized as Student, Parent, Faculty or Administrator. Mean and ranking were used in finding the average acceptability level of the stakeholders as a whole and the areas in the implementation of the new curriculum that encountered major problems respectively. Finally, the significant relationship between the acceptability level of the STEM program and the difficulty level of problems encountered was determined using Pearson's Moment Product Coefficient of Correlation. According to Broto (2006), Pearson's coefficient of correlation must be used in determining the significant relationship of an independent and a dependent variable. The relationship was tested using t-test at 0. 05 level of significance. This study covers S.Y. 2016- 2017--the first year of implementation of the Senior High School.

RESULTS AND DISCUSSION

Acceptability level of the Senior High School- STEM curriculum

Table 1 presents the acceptability level of the STEM Track Curriculum of Sorsogon State College SHS among its stakeholders. Among the stakeholders are Students, Parents, Faculty Members and Administrators of the SHS. In the table, it can be observed that the acceptability level of the curriculum among Students and Parents were both low while that of the Faculty Members and Administrators were overwhelmingly high and very high respectively. The acceptability scores of students and parents were 48.16 and 43.60 only while those of the Faculty Members and Administrators were 77.40 and 82.33 respectively. These results made up an overall acceptability score of 48.16 which means the acceptability level of the total respondents on the implementation of the curriculum was low.

The low acceptability among Students and Parents may be attributed to their belief that the old 4-year high school curriculum must be better than the newly implemented since the former has shorter number of years. It could also be that most parents perceive the additional two years as another burden for them since instead that their children could work already after 4 years in high school, the SHS program would oblige their children to pursue to finish the two more years for them to be considered as graduates in the basic education.

Another possible reason for this result could be the minimum knowledge and awareness of both the parents and the students about the possible employment

advantages and opportunities of the SHS program. Contrary to faculty members and school administrators who have the knowledge regarding the new curriculum since they have been exposed to several seminars regarding the K-12 SHS implementation, the parents and students have low acceptability of the program as compared to the former. Thus, it can be inferred that knowledge and awareness regarding the benefits of the newly implemented program was likely a cause of this finding.

Table 1. Acceptability Level of the STEM Curriculum among Stakeholders

Stakeholders	Acceptability Score ($\dot{x}$)	Remarks
Students	48. 16	Low
Parents	43. 60	Low
Faculty	77. 40	High
Administrators	82. 33	Very High
Overall	**48. 16**	**Low**

This result is similar to the study of Guerrero (2010) on the acceptance of the Ubd Curriculum among public school teachers and administrators during its first three months of implementation. The study showed that the acceptance level of the curriculum was very low among public school teachers, while very high among administrators. Sabaldica (2004) also have the same findings in his study about the acceptability of the Basic Education Curriculum (BEC) among public elementary teachers in 2003. It can be noted that he mentioned in his study that the acceptability level of the curriculum among elementary teachers after its first 2 months, 4 months, 6 months and 1 year of implementation were very low, very low, low and high respectively. This signifies that the acceptability level of a new curriculum upon its early stages of implementation is consistently low but as intervention programs were implemented, the level increases.

The findings of the research of Supremo as cited by Sabalica (2004) supports this idea which revealed that after exposure to seminars and conferences regarding the K-12 Curriculum, faculty and administrators of SUCs' laboratory high schools in Region VIII accepted the new program. With weighted means of 4.0, 4.2, 4.0, 4.1, 4.2 and the average of 4.1 out of 5, the respondents in this study registered high acceptability of the implementation of the new curriculum for the reason that the stakeholders were exposed to K-12 gatherings and consultations, and they believe that the SHS program will improve the quality of education, These results mean that majority of the SSC stakeholders have negative acceptability on the new curriculum. This would also mean that stakeholders perceive the new curriculum as not beneficial to students. According to Davis (1951), one of the methods of ensuring the success of a certain program is to ensure the support of the people who have direct relation to it. Thus, there is a profound need to consider the acceptability of the STEM curriculum among its stakeholders.

Furthermore, the respondents also do not regard the implementation of the program essential to achieve quality education. With these results, it can be deduced that stakeholders do not totally support the implementation of the SHS-STEM program. This suggests that a comprehensive understanding of the significance of the SHS program is needed among stakeholders.

Problems encountered along the Implementation of the Implementation and their Difficulty Level

Reflected in table 2 are the findings on the different areas in the implementation of the SHS-STEM curriculum that encountered problems and their respective difficulty level. The table shows that among the six areas namely: curriculum, learners, faculty, facility, instructional materials and instruction, the areas that encountered major problems along its implementation were the Facility and the Instructional Materials which ranked first and second among the six areas of the implementation respectively. Although there was an existing budget allocation for the SHS program, however the priority was allotted for other concerns in the tertiary level. This could be attributed to the fact that offering SHS program was not a mandate of an SUC. It can also be cited that the offering of the SHS program was only permitted by the Commission on Higher Education among SUCs for the K-12 transitional periods only since there was a predicted decline in the number of freshmen enrollees in colleges and universities (CHED, 2015). Since SUCs are primarily mandated to provide quality tertiary education and not SHS education because it is the mandate of the Department of Education, their engagement in basic education through SHS programs will be limited only until 2021 (CHED, 2015) and therefore the budget for facilities was not that big as per evaluation of the SSC budget priorities.

Nevertheless, the problems on the area of Facility could have been addressed through the assistance of supportive stakeholders. It can be noted that in the

previous findings, the acceptability of the new curriculum was low which means the support of the stakeholders was not 100% on the implementation of the new program. Thus, this signifies that a good relationship with the external stakeholders must be established by the school. The results reveal further that the only area that has less problems encountered and need no major improvements was the Faculty which only ranked 6th among the six areas. This may be attributed to the efficient and strict implementation of the SSC Faculty Screening and Development Program.

Table 2. Problems encountered and their level of difficulty along implementation

Areas of STEM program	Difficulty Score (X)	Remarks	Rank
Curriculum	17.40	High	3
Learners	15.58	High	5
Faculty	10.84	Low	6
Facility	20.91	Very High	1
Instructional Materials	20.47	Very High	2
Instruction	15.79	High	4
Overall	16.89	High	-

The findings also present that major areas that encountered Very High difficulty level problems were the Facility and Instructional Materials also with difficulty scores of 20.91 and 20.47 respectively. It can be observed as well that both these areas encountered Very High difficulty level of problems during the implementation of the program. Since, the budget allocation for these two areas of the SHS program was not a priority of an SUC like the SSC, thus these findings. It must be mentioned likewise that the implementation of the SHS program was not also within the mission and vision of the institution (SSC Student Handbook, Revised 2010).

Moreover, the other areas – Curriculum, Learners, and Instruction encountered high difficulty level problems with difficulty scores of 17.40, 15.58 and 15.79 correspondingly. The possible reason for the result on the area of Curriculum could be the inexistence of a comprehensive academic manual for both students and teachers where the course description of the subject areas, the course requirements, their number of units, and their prerequisite subjects are clearly defined. Although these pieces of information are readily downloadable on the website of the Department of Education, the students still look for a tangible curriculum guide that is accessible by everyone. This culture of students with a copy of their academic manual can be attribute to the strong implementation of this matter in the Laboratory High School (Junior High School) of the institution where every student has the full access on all their academic records through individual copy of student handbook, academic manual, and curriculum guides.

Likewise, for the area of Learners, the possible cause of the High difficulty level of the problems encountered during the implementation of the program could be the exemption of some students to undergo the Student Admission Policy and the inexistence of a Student Retention Policy for SHS-STEM Students. It must be mentioned that although an admission test had been administered to qualify STEM Students, this was done only for students who were junior high school completers from other schools excluding the students of SSC Laboratory Junior High School. Since total absorption of junior high school completers was applied and no qualifying test was conducted to screen this group of students, 67 out of 178 or 37.64 % of the total number of enrollees were accepted in the STEM Track of the school. It is also possible that these unscreened students do not have Investigative remarks in their NCAE results which must be the primary consideration in choosing the STEM Track in career plotting. Because of these reasons, it was not a surprise that most of these students got lower grades in core mathematics subjects namely Pre– Calculus, Basic Calculus, General Mathematics, and Probability and Statistics.

Furthermore, for the area of Instruction, since there were existing problems in the areas of Facility, Instructional Materials, Curriculum and even Learners, thus the results. Another possible reason could be the lack of training of some of the faculty members of the SHS program. Out of seven faculty members, only two attended a training- seminar prior to the start of the school year in preparation for the full-blast implementation of the K-12 SHS Program. It should also be mentioned that for the two semesters, no seminar or training for SHS faculty was held as compared to their public school counterparts who enjoyed a number of conferences and trainings which contributed to the preparedness of their faculty in offering SHS program.

On the other hand, only the area of faculty was perceived by the stakeholders to have low difficulty level problems with difficulty score of 10.84. In the entirety, the difficulty level of problems as perceived by the stakeholders was high with overall difficulty score of 16.89. The results suggest that improvements on areas of Curriculum, Learners, Facility, Instructional Materials, and Instruction must be done.

Correlation of Acceptability Level of the Curriculum and the Difficulty Level of Problems along its Implementation.

Based on the results of the perceived acceptability and the difficulty level of the implementation of Sorsogon State College SHS-STEM curriculum, the two variables were correlated using Pearson's Product Moment Coefficient of Correlation. The computed value of Pearson r was -0.77 (negative) which means there is moderate inverse relationship between the acceptability level of the curriculum and the difficulty level of the problems. The computed Pearson r is shown in table 3.

Table 3. Pearson r and t- value of acceptability and difficulty level

Statistical Basis	Statistical Analysis
n	101
df	99
r- value	-0. 770
strength of relationship	moderate inverse
t- value	12. 01
t- critical value	1.671
decision	reject
remarks	significant

Since the computed t-value 12. 01 exceeded the critical t- value 1. 671, the null hypothesis is rejected. Considering this result, it can be deduced that the acceptability level of the STEM curriculum is significantly related to the difficulty level of the problems encountered along its implementation.

Proposed Interventions

After determining the different areas in the implementation of the SHS-STEM Program of Sorsogon State College that encountered major problems and have high difficulty level, several interventions were developed to address the problems.

For the area of Facility, an Inter-departmental Facility Utilization Policy (I-FUP) among the three departments of the college was developed and proposed. The proposed policy aimed to address the problem of lack of facility of the SHS program. Specifically, the goalsof the proposed intervention were: (1) provide facilities needed in the implementation of the SHS curriculum so as to satisfy the authentic needs of the learners, (2) maximize the resources of Sorsogon State College thru utilization of existing facilities of the institution, and (3) ensure quality instruction by providing educational facilities without spending beyond the capability of the institution. Through this policy, the institution could save a large amount of resources since instead of allotting separate budget allocations for the facilities of the SHS program, the existing facilities of other departments will be utilized.

For the area of Instructional Materials, a Short Training Course on Instructional Materials Making for SHS Teachers was conceptualized and proposed to the administrators of Sorsogon State College. The primary goal of this intervention was to address as well the problem on lack of instructional materials especially textbooks for SHS. Specifically, the proposed intervention aimed to: (1) provide instructional materials needed in the implementation of the SHS curriculum and thereby address the present needs of both the institution and the students, (2) maximize the resources of the institution by asking the expertise of the faculty members in the development of quality instructional materials for SHS, and (3) save a large amount of resources of the institution by asking the assistance of the external stakeholders specifically the PTA in the production of the instructional materials. In this proposed intervention, the problem on instructional materials would be solved and the strong bond between the institution and stakeholders would be reinforced as well.

For the area of Curriculum, a separate Academic Manual and Student Handbook for SHS was recommended to be proposed. These proposed materials would clearly define the subject areas, course descriptions, number of units, course requirements and the prerequisite subjects of the students who are taking the STEM Track. Specifically, this aimed to: (1) provide a comprehensive curriculum manual for students, teachers and other stakeholders where the

nature and components of the subject areas are clearly defined, and (2) settle all academic concerns about the implementation of the SHS program thru the proposed manuals.

For the area of the Learners, an efficient implementation of the Student Admission and Retention Policy was proposed. In this proposed intervention, it was recommended that all applicant enrollees for the SHS-STEM program must undergo the Admission Test or at least must have the Investigative remarks in their NCAE Results to ensure that the students who take the STEM Program are really qualified, since according to studies (DepEd, 2016), failure to do this would only increase the problem on low cohort survival rate, and thus might increase the dropout rate due to mismatch of the student's interest and choice of track. Specifically, this proposed intervention aimed to: (1) ensure the welfare of the students by safeguarding that the track they are to take in SHS is in line with their ability and interest, and (2) secure quality graduates of the SHS program by admitting only qualified students in the STEM Program.

Finally, for the low acceptability level of the implementation SHS - STEM Curriculum, a series of Re-orientation about the K-12 STEM Curriculum among Stakeholders was conceptualized and proposed. A series of mini- seminars or re- orientation sessions about the K-12 SHS program must be done among stakeholders especially for parents since it was found out that the acceptability of this group of stakeholders was very low. In this regard, prior to the conduct of these activities, access of the faculty members in national and international seminars and conferences regarding the implementation of the SHS program must be maximized. The purposes of this proposed intervention were: (1) to increase the acceptability of the SHS Program among stakeholders and thereby decrease the difficulty level of problems encountered along its implementation thru constant collaboration with these partners of the institution, (2) to raise the awareness of the stakeholders and the community about the significance of the K-12 SHS Program, (3) to develop strong relationship among the stakeholders of the institution, and (3) to address the academic concerns and problems of the school and the students thru the direct involvement of the stakeholders and the community.

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The Radical Scavenging Activity and Effect on Liver Function Enzyme Marker Alanine Aminotransferase of the Flavonoid Extract from the Leaves of Himbabao *(Broussonetia luzonica)* Moraceae

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ABSTRACT

This study investigated the radical scavenging activity and effect in liver function enzyme markers alanine aminotransferase (ALT) of flavonoid extract from the leaves of himbabao. Tests for physical, chemical and infrared characteristics of the prepared himbabao extract confirmed that it is a flavonoid. The antioxidant activity of the flavonoid extract of himbabao was determined through in vitro tests using 1, 1-diphenyl-2-picryl hydrazyl (DPPH), nitric oxide and superoxide scavenging assays, in comparison with standard antioxidants – ascorbic acid, quercetin and silymarin. The effectiveness of the Himbabao flavonoid extract as a hepatoprotective agent was measured by its ability to normalize ALT level using carbon tetrachloride (CCl4) induced hepatotoxic Wilstater rats. The hepatoprotective activity of the extract was compared to the standard hepatoprotective agent, Silymarin. The flavonoid extract of himbabao showed an antioxidant activity in concentration dependent manner when tested directly using DPPH, nitric oxide and superoxide scavenging assays. The three doses (40 mg/kg, 100 mg/kg, 200mg/kg) of the flavonoid extract of himbabao were able to lower down the ALT level of the CCl4- induced rats in similar effect. Therefore, the flavonoid extract of himbabao possesses antioxidant and hepatoprotective activities.

KEYWORDS: Phamacognosy, radical scavenging activity, alanine aminotransferase (ALT), flavonoid, himbabao *(Broussonetia luzonica)* Moraceae, Philippines

INTRODUCTION

Antioxidants are vital substances that possess the ability to protect the body from damage against free radical – induced oxidative stress. Several plant constituents due to their structural properties have antioxidant activities. Among these are flavonoids which are polyphenolic colored substances that occur in great quantities in plants especially in some plant parts like the leaves. The phenolic compounds can inhibit oxidation in many ways through radical-scavenging activity or through their metal-chelating properties, of which the former may dominate (Marinova et al., 2005).

Antioxidants are particularly necessary for liver health as this largest organ maintains the body's internal milieu with its detoxifying function and built-in regeneration system. It is involved in the biochemical conversions of various endogenous and exogenous substances, generating various highly reactive species of free radicals. Some free radicals generated by certain hepatotoxins like the drugs rifampicin and paracetamol, chemical substances like alcohol and carbon tetrachloride may overpower the protective mechanism of the liver and cause hepatic damage (DOH, 2011). Hepatic damage can lead to certain complications like hepatitis, cirrhosis and liver diseases (Queshi et al., 2007).

Liver health is reflected by the serum levels of liver function enzyme marker alanine aminotransferase (ALT), formerly called serum glutamic pyruvic transaminase (SGPT). Liver damage releases the enzyme into circulation, therefore it can be measured in serum without resorting to taking liver samples. ALT catalyzes the conversion of alanine to pyruvate and glutamate and is more specific to the liver. High levels of ALT indicate acute hepatitis or damage, but in a clinical situation normal levels are found in very advanced disease and alcoholic hepatitis (Williamson et al., 1996).

Numerous studies have focused on flavonoids' antioxidant activity, which is often correlated with their hepatoprotective property. For instance, antioxidants have been shown to protect cells and tissues against the effects exerted by reactive oxygen species, thus can act as hepatoprotective agents as they exert positive effect on intact liver cells or cells not yet irreversibly damaged and also stimulate their regenerative capacity after partial hepatectomy (Arteel, 2003). These are usually observed as ALT in group of animals given doses of antioxidants normalized.

The flavonoid silymarin and its components have been shown to be antioxidant and hepatoprotective as scavengers and regulators of the intracellular content of glutathione, and as cell membrane stabilizers and permeability regulators to prevent hepatotoxic agents from entering hepatocytes. These

substances also promote ribosomal ribonucleic acid (RNA) synthesis, stimulating liver regeneration and as inhibitors of the transformation of stellate hepatocytes into myofibroblasts which is responsible for the deposition of collagen fibres leading to cirrhosis (Fraschini et al., 2002). Thus, it might have been the reason why silymarin is accepted as a good hepatoprotective agent. However, the plant material to which silymarin is obtained is not growing in the Philippines.

There are many locally grown plants that contain flavonoids. Among the least studied is Himbabao, *Broussonetia luzonica* (Blanco) from the Family Moraceae. Its flowers and young leaves have been only extensively used as an ingredient in cooking to add texture and subtle aroma (Siosin, 2009). Until now, no studies have been conducted on any of its parts.

Study Objectives. This study evaluated the radical scavenging activity and effect in liver function enzyme markers ALT and AST of the flavonoid extract from the leaves of himbabao *B. luzonica.* Specifically, it determined the a) phenolic acid and flavonoid contents, and chemico-structural properties of the himbabao flavonoid extract; b) antioxidant activities of the extract by DPPH, nitric oxide, and superoxide radical scavenging assays; and their difference compared with those of positive control ascorbic acid, quercetin, and silymarin using their inhibitory concentrations (IC_{50}s); c) effect of different doses of the extract on ALT levels of carbon tetrachloride (CCl_4) induced hepatotoxic Wilstater rats; and their difference compared with that of Silymarin as positive control.

METHOD

The experiments in this study were mostly conducted at the Graduate Pharmacy Laboratory of the Manila Central University. Animal testing was conducted at the Pharmacology Department of the University of the Philippines. ALT analysis was performed by Cytochem Laboratories in Caloocan City.

Preparation, characterization, and antioxidant activity determination of himbabao flavonoid extract

The fresh leaves of himbabao were collected from Isabela and authenticated at the Botany Division of the National Museum. The leaves were air dried, pulverized, kept in a clean well-sealed glass container, and subjected to 24-hr continuous Soxhlet extraction.

Characterization of the himbabao flavonoid extract. The characteristics of the extract were physically and chemically assessed. Infrared spectroscopy was employed to determine the functional groups present and confirm the presence of flavonoids. Quantitative determination of the phenolic and flavonoid content was performed using gallic acid and quercetin, respectively, as standards.

Determination of the radical scavenging activity of the himbabao flavonoid extract. The antioxidant activity of the himbabao flavonoid extract was determined using in vitro scavenging assay for 1, 1-diphenyl-2 picrylhydrazyl (DPPH, an organic chemical compound used in a stable free radical method that is easy, rapid sensitive way to survey the antioxidant activity of a specific compound or plant extracts, Koleva et al., 2002); nitric oxide and superoxide radical scavenging. Inhibitory concentrations were compared with three antioxidants used as reference controls – ascorbic acid, a vitamin-antioxidant; quercetin, a natural product; and silymarin, a natural hepatoprotective agent.

Bioassay

Prior to bioassay, the approximate lethal dose was determined using 16 Swiss mice, each weighing 16-24 g at the start of the experiment, divided into eight groups with one male and one female per group. Different doses of the extract starting at a dose of 10 mg/kg and an increment of 0.6 log dose were administered. Likewise, 16-24 g Swiss mice were used to test the safety of the flavonoid extract by the median lethal dose (LD_{50}). Different groups of mice were given different doses of the flavonoid extract starting from 10,000 mg/kg BW with increments of 0.6 log dose. The median lethal dose was computed using the Probit method. Institutional approval for the use of animals in the procedures was secured; care for the test animals in all procedures was observed.

The procedure for biological test for hepatoprotective activity measured the ability to normalize liver function enzyme marker, ALT on CCl_4 induced hepatotoxic Wilstater rats. This test was derived from the study performed by Prakash, 2008.

Preparation of test animals. Thirty-five Willstater male rats weighing 100-130 g were grouped into seven control groups consisting of the non-hepatotoxic control group fed with normal animal feed (group 1), non-hepatotoxic group with the flavonoid extract of himbabao (group 2), hepatotoxic control group fed with normal animal feed (group 3), hepatotoxic group with the flavonoid extract of himbabao (group 4, 5, 6) and hepatotoxic group with Silymarin (group 7). All

animals were acclimatized for seven days before treatment commenced.

Induction of hepatotoxicity. Administration of doses was given through intraperitoneal route of administration daily for seven days. The rats in group 1 received normal saline 5 mL/kg. The rats in group 2 received flavonoid extract of himbabao diluted with NSS at a dose of 100 mg/kg. The rats in group 3 received carbon tetrachloride diluted with olive oil at a dose of 1ml/kg without any drug treatment. Group 4, group 5 and group 6 were given different doses of the flavonoid extract of himbabao (40,100,200 mg/kg, respectively) from day 1 to 5 with concurrent administration of CCl_4 at a dose of 1ml/kg on day 2 and 3. Group 7 was given Silymarin at a dose of 100 mg/kg orally from day 1 to day 5 with concurrent administration of CCl_4 at a dose of 1ml/kg on day 2 and 3.

Blood and tissue collection. The test animals were fasted for 24 hours prior to collection of blood baseline level of ALT. Blood was also collected from the test animals on the 6th day and the serum was tested for enzyme levels of ALT. Blood from the rats was obtained by cutting the tail of the rat ½ to 1 inch from the end. The blood was centrifuged at a rate of 3000 rpm for 15 minutes. The serum obtained was then subjected to ALT analysis at Cytochem Laboratories.

Statistical treatment of data

The data on the radical scavenging activities of the himbabao flavonoid extract and those of the positive control were measured by their median inhibitory concentrations (IC_{50}). Significant difference in their IC_{50} was determined by F-test and least mean square difference analysis.

The hepatoprotective activity of the different doses of the extract and silymarin was expressed by comparing ALT enzyme levels of himbabao treated groups and silymarin treated group with purely CCl_4 treated group. Significant differences between paired groups were determined by t-test (Asaad, 2000).

RESULTS AND DISCUSSION

Phenolic and flavonoid content, and physico-chemical properties of the himbabao flavonoid extract

The average percentage yield obtained from the extraction of flavonoids through continuous process was 5.47%, implying that the leaves of himbabao contain a considerable amount of flavonoid. This amount is higher than that obtained from the leaves of devil fig, *Ficus hispida* (2.33%), a plant belonging to the same family as himbabao (Marinova et al., 2005). However, the amount of the flavonoid extract of himbabao is lower compared to other members of the same family such as white mulberry, *Morus alba* that yields 23.40% (Radajkovic, 2011). The flavonoid extract has a very dark green color and sweetish odor. It is viscous and resembles semisolid consistency. An aqueous solution of the flavonoid extract has a pH of 6.

Quantification of the total phenolic and flavonoid contents in the extract revealed 19.42 mg gallic acid equivalent and 29.93 mg quercetin equivalent, respectively per gram of sample. The obtained flavonoid content of the extract is superior over that of commonly used vegetables like cabbage *(Brassica oleracea)* 19.29 mg/g, fruit of red pepper *(Capsicum frutescens)* 24.78 mg/g, bulb of onion (Allium cepa) 10.23 mg/g and fruit of tomato *(Lycopersicon esculentum)* 12.62 mg/g (Olajire & Azeez, 2011). It is also comparable with the total flavonoid content of the members of the same family like *Morus alba* leaf with 33.30 mg/g and *Morus nigra* leaf with 67.37 mg/g (Faculty of Technology, University of Novi Sad, 2011). Flavonoids are not just responsible for the attractive colors of flowers, fruits and leaves but have beneficial effects on health as well (De Groot et al., 1998). Their best described properties include their capacity to act as antioxidant (De Groot, 1994), antiatherosclerotic (Hertog et al. 1993), anti-dementia (Scotet et al., 2000), anti-inflammatory (Ferranciz & Alcaraz, 1994), antitumor (Poulsen, 1996), antithrombogenic (Gryglewski, 1987), antiosteoporotic (Hegarty, 2000), and antiviral (Wang et al., 1998).

Infrared spectroscopy on the himbabao flavonoid extract produced frequencies that correspond to the peaks obtained with quercetin as standard (figure 1). Notably, the himbabao extract and the standard gave almost similar band frequencies conforming to O-H, alkanes, carbonyl group like ketone group and sp^3 hybridized carbon, which are characteristic functional groups of polyphenolic compounds and flavonoids (table 1).

Table 1. Infrared frequencies of the himbabao flavonoid extract

Quercetin IR Band frequencies (cm^{-1})	Himbabao flavonoid extract frequencies	Functional groups indicated; Interpretation
3422.42	3365.28	O–H for alcohols & phenols (H-bonded); broad and strong intensity
1615.30	1604.54	C=C for Alkenyl & carbonyl groups; variable intensity
2922.90	2927.79	C–C for Alkanes
2857.06	2854.10	sp3 C–H bond

The superimposed spectra of the himbabao flavonoid extract and quercetin in figure 1 do not show exactly the same peaks; the difference may be because of the other flavonoids present in the extract since the extraction procedure conducted is for the total flavonoid and not a specific isolation of quercetin.

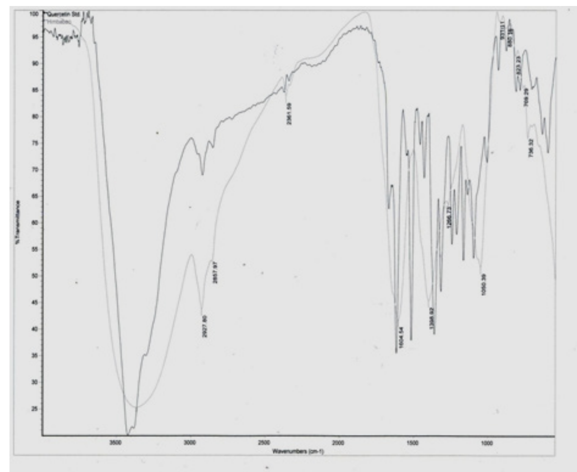

Figure 1. Superimposed IR spectra of himbabao flavonoid extract and quercetin

Radical scavenging activity of the himbabao flavonoid extract

The Himbabao Flavonoid Extract and the three known antioxidant standards (ascorbic acid, silymarin, quercetin) were exposed to free radicals DPPH, nitric oxide, and superoxide in order to assess the antioxidants' inhibitory action on the radicals. DPPH is an organic radical compound that's commercially prepared for use as substrate for any specific compound of plant extract's antioxidant activity. Nitric oxide is a free radical involved in regulation of various physiological processes but an increase in its level in the body is associated with several diseases. Superoxide anion radical is one of the strongest reactive oxygen species among the free radicals that are generated first after oxygen is taken into living cells. Superoxide changes to other harmful reactive oxygen species and free radicals such as hydrogen peroxide and hydroxyl radical.

Table 2 shows the IC_{50} of the himbabao extract and known antioxidants against the free radicals DPPH, nitric oxide, and superoxide. Analysis of the spectrometry absorbance readings reveals that the himbabao flavonoid extract possesses a concentration dependent antioxidant activity in vitro.

Table 2. Mean values of IC_{50} against free radicals of the himbabao flavonoid extract and known antioxidants

Antioxidant	Free radical inhibition (IC_{50} , mg/mL)		
	DPPH	Nitric oxide	Superoxide
Himbabao Flavonoid Extract	15.77	64.41	97.34
Ascorbic Acid	0.27	16.13	24.64
Silymarin	7.90	21.15	99.11
Quercetin	6.65	49.99	86.17

Consistently, the vitamin antioxidant ascorbic acid manifests the highest capacity to scavenge the radicals DPPH, nitric oxide, and superoxide as the concentrations of 0.27 mg/mL, 16.13 mg/mL, and 24.64 mg/mL are enough to inhibit 50% of the radicals, respectively. On the other hand, the himbabao flavonoid extract showed the highest concentration required to inhibit 50% of DPPH and nitric oxide. This is expected as the extract is only partially purified. Reports of IC_{50} values of some plant extracts however is even higher to what

have been obtained for the flavonoid extract of himbabao ranging from 22.1-92.30 mg/mL (Olajire & Azeez, 2011). Notably, the extract proved to be a little stronger than silymarin in inhibiting 50% of the superoxide.

The obtained DPPH inhibition value is better than that obtained in previous research (IC_{50} of 0.011 mg/mL, Sasikumar et al., 2010). Silymarin, a known hepatoprotective agent and quercetin, a known antioxidant of plant origin exhibit almost similar IC_{50} values against DPPH.

Difference between the radical scavenging activities of the himbabao flavonoid extract and known antioxidants

F-test was used to compare IC_{50} values obtained among the different antioxidants. Calculations were at an alpha level of 0.01. The results of the F-test for DPPH radical scavenging activities between the himbabao flavonoid extract and the various antioxidants show that there is a significant difference in the DPPH scavenging activity of the himbabao flavonoid extract and that of ascorbic acid, quercetin and silymarin. Similarly, there is a significant difference in the nitric oxide and superoxide radical scavenging activities of the flavonoid extract of himbabao and the antioxidants ascorbic acid, quercetin and silymarin.

The differences in the DPPH inhibition (IC_{50} mean values) of the four antioxidants (himbabao extract, ascorbic acid, silymarin, and quercetin) when they are paired against each other were proven significant by least square mean difference statistical analysis. Likewise, the differences in their nitric oxide and superoxide inhibitory activities were all revealed significant in favor of the known antioxidants used as positive control. These confirm the significant difference in between and within groups computed in F-test These results imply that despite inhibitory actions of the himbabao flavonoid extract against the three radicals DPPH, nitric oxide, and superoxide, it did not equal the inhibitory actions of ascorbic acid, silymarin, and quercetin.

Bioassay

Sixteen (16) Swiss mice were observed for any physiological changes and for deaths. The approximate toxicity dose is in between 10,000 mg/kg and 25,000 mg/kg of the flavonoid extract of himbabao. This implies that the flavonoid extract of himbabao is relatively safe. The toxicity of the flavonoid extract was observed for seven days. The median lethal dose (LD_{50}) was computed to be 23,930 mg/kg.

Effect of the himbabao flavonoid extract on serum ALT levels

Computation of mean baseline ALT levels within and among different groups shows that they do not vary much (table 3). F-test results comparing the mean ALT levels among the different groups show no significant difference.

Table 3. Mean serum ALT levels of Wilstater rats

Group	Treatment	Serum ALT (mg/dL)		
		Baseline	Posttest	% change
Normal Control	NSS	71.99	59.29	-17.64
Flavonoid Group	Flavonoid alone 100mg/kg	77.27	52.39	32.19
Negative Control	CCl4 1ml/kg	66.02	230.86	249.68
Positive Control	CCl4 + Silymarin 100mg/kg	54.75	70.74	29.21
Experimental-1 (E1)	CCl4 + 40 mg/kg extract	59.34	83.10	40.04
Experimental-2 (E2)	CCl4 + 100 mg/kg extract	63.01	75.15	19.27
Experimental-3 (E3)	CCl4 + 200 mg/kg extract	58.66	72.85	19.74

The administration of the extract alone in the rats gave a lowering in ALT levels of about 32.17% from baseline levels showing that the extract has hepatoprotective activity even in normal rats. The administration of CCl_4-induced hepatotoxicity as shown by the tremendous increase in ALT levels equivalent to about 250%. However, the administration of different doses of the flavonoid extract of himbabao were able to lower down the ALT levels but not reaching baseline levels after 5 days of administration. The dose of 100 and 200 mg/kg cause similar effect on ALT levels and is even better giving a higher lowering effect than 100 mg/kg silymarin. Though a dose of 40 mg/kg had an effect on serum ALT levels as implied by a higher post test ALT value in the group given CCL_4 alone compared to that of the group given 40 mg/kg, the effect was not as comparable to that of 100 and 200 mg/kg dose of flavonoid extract.

Difference between the hepatoprotective activity (based on effect to ALT levels) of the himbabao flavonoid extract of and silymarin

Table 4. Results of t-test comparing ALT levels of rats given different doses of himbabao flavonoid extract from that of Silymarin

Groups Being Compared	T computed	Interpretation
PC vs. EC1	0.50	Not significant
PC vs. EC2	0.41	Not significant
PC vs. EC3	0.17	Not significant

Legend: PC= Silymarin, 100 mg/kg; E1= Flavonoid Extract, 40 mg/kg; E2= Flavonoid Extract, 100 mg/kg; E3= Flavonoid Extract, 200 mg/kg; T crit α=0.01=2.896

Table 4 shows that the dose of 40,100 and 200 mg/kg extract gave no significant difference in effect in ALT levels as that of 100 mg/kg Silymarin when tested statistically at an alpha level of 0.01.

Therefore, the difference in ALT levels of the groups given 100 mg/kg and 200 mg/kg flavonoid extract of himbabao from Silymarin (100 mg/kg) is not statistically significant and a dose of 40,100 and 200 mg/kg of the flavonoid extract of himbabao has comparable effect in ALT levels compared to that of Silymarin 100 mg/kg. This result implies that the effectiveness of all employed doses of the himbabao flavonoid extract in lowering ALT levels of hepatotoxic subjects could be similar.

Table 5. Result of the t-test comparing the ALT levels of rats given different doses of himbabao flavonoid extract

Groups Being Compared	T computed	Interpretation
EC1 vs. EC2	0.30	Not significant
EC1 vs. EC3	0.38	Not significant
EC2 vs. EC3	0.15	Not significant

Legend: E1= Flavonoid Extract, 40 mg/kg; E2= Flavonoid Extract, 100 mg/kg; E3= Flavonoid Extract, 200 mg/kg; Tcrit α: 0.01=2.816

The t-test showed that there was no significant difference when paired means of the ALT levels of rats in the three groups were compared. Thus, this suggests that the effect of 40,100 and 200 mg/kg of the flavonoid extract of himbabao on ALT levels are similar.

Conclusions. Based on the findings, it is concluded that himbabao *(Broussonetia luzonica)* contains flavonoids that possess dose-dependent radical scavenging activities similar to antioxidants ascorbic acid, quercetin and silymarin. Therefore, it can be used as an alternative antioxidant agent. The different doses of the flavonoid extract of himbabao were able to lower down the ALT levels. The effect of 40 mg/kg of the flavonoid extract of himbabao was not comparable to that of 100 and 200 mg/kg of the flavonoid extract of himbabao. However, there was no significant difference among the doses when paired means of the ALT levels of rats in three groups were compared. The lowering effect on ALT levels of 40mg/kg, 100 mg/kg and 200 mg/kg of the flavonoid extract of himbabao on ALT levels are similar. Thus, the flavonoid extract of himbabao can be used as a hepatoprotective agent.

Recommendations. Further isolation and characterization of the flavonoid extract of himbabao should be done using other methods. Histopathological examination of the liver should be conducted to further determine the effect of the extract to the liver. Formulation of a suitable dosage form for its use as an alternative dietary antioxidant and hepatoprotective supplement may be looked at.

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International Journal of Education Research for Higher Learning
Vol. 22 No. 2 October 2016
Print ISSN 1656-0604
Online ISSN 2244-6532

Antiangiogenic and Antioxidant Properties of Calamansi *Citrus microcarpa* Distilled Essential Oil and Amber Crude Oil

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ABSTRACT

This study evaluated the antiangiogenic and antioxidant properties of Calamansi *Citrus microcarpa* distilled essential oil and amber crude oil. Fourier Transform Infrared Spectroscopy (FTIR) and Gas Chromatography – Mass Spectrophotometry (GC-MS) analysis on the distilled essential oil revealed alkenes, alcohols, alkanes, alkyls, ketones, aldehydes, carboxylic acids and aromatics with 29 constituents, while alkenes, alkanes and hydrocarbons with 38 constituents were found in the amber crude oil. Terpenes made up most of the constituents with the monoterpenic limonene comprising majority of both oils (80.39% and 71.85%). Limonene oxide, beta-myrcene, cis-carveol and trans-carveol dominated both the calamansi oils. Both register under category 5 acute oral toxicities, based on the OECD 423 Guidelines, with a toxicity range of 2000-5000 mg/kg. By CAM Assay, the antiangiogenic property was determined. There is no significant difference in the primary and secondary blood vessels but there is a significant difference in the tertiary blood vessels between the two calamansi oils and bevacizumab. Determining antioxidant activity by DPPH Assay also reveals a significant difference in the mean free radical scavenging activity between the two calamansi oils and ascorbic acid.

KEYWORDS: Pharmacy, *Citrus microcarpa*, crude oil, essential oil, Fourier transform infrared spectroscopy (FTIR), gas chromatography – mass spectrometry (GC-MS), antiangiogenic, antioxidant, Philippines

INTRODUCTION

Nowadays, the increasing incidence of a number of diseases such as cancer, diabetic retinopathy, osteoarthritis and other inflammatory diseases have caused alarm to the general public (Medicine Net, 2013; Medline Plus, 2013; Zheng & Congdon, 2012). With changes in lifestyle, environment and habits, it came as no surprise that these kinds of diseases have become more common. As treatment, targeting the pathways causing the diseases can be done in a number of ways but the path that they all have in common is the inhibition of angiogenesis.

Pathological angiogenesis is a hallmark of cancer, rheumatoid arthritis, Crohn's disease, diabetic retinopathy, psoriasis and endometriosis (Griffioen et al., 2000). Likewise, it is an emerging key player in the pathogenesis of several chronic inflammatory and rheumatic diseases (Ribatti et al., 2013).

Driven by a growing and ageing population, the World Health Organization (2013) also forecasted a total of 7.6 million people dying from cancer worldwide in 2008 and it is projected to continue to rise to over 13.1 million in 2030. In the Philippines, it is predicted that cancer incidence will increase to roughly 82,468 new cases annually in both males and females (Reyes, 2013).

These diseases may benefit from therapeutic inhibition of angiogenesis, which is the formation of new blood vessels out of pre-existing capillaries (Griffioen et al., 2000). At present, scientists are studying natural and synthetic angiogenesis inhibitors, also called antiangiogenic agents, with the idea that these molecules will prevent or slow the growth of cancer (National Cancer Institute, 2011).

The Philippines has a diverse array of plant resources, yet a number of scientists feel that these resources are not fully utilized in the search for new antiangiogenic agents that would interfere with the various steps of angiogenesis implicated in various pathologies such as cancer or chronic inflammation (Olarte, 2007).

Plant-derived essential oils are natural, complex and multi-component systems composed mainly of terpenes as well as some other non-terpene components (Goze et al., 2010). Many studies have shown that a large number of terpenoids and aromatic compounds contained in essential oils have significant anticancer activities, some of which are the production of free radicals in cancer cells and inhibition of angiogenesis (Lesgards et al., 2014).

Calamansi, a native citrus plant cultivated throughout the Philippines, is an important crop and an outstanding ornamental plant (Food and Nutrition Research Institute, 2007). Studies show this plant contains monoterpene

hydrocarbons and sesquiterpenes (Chen et al., 2013).

The chick chorioallantoic membrane assay has been widely used to study angiogenesis (Sri et al., 2013). The chorioallantoic membrane of the chick embryo provides a unique model for investigating the process of new blood vessel formation and vessel responses to antiangiogenic agents (Miller et al., 2004).

Being a reservoir of antioxidants and detoxifiers, calamansi have been seen to eliminate the free radicals and toxins, thus preventing gout, age-related vision disorders as well as cancers (Antioxidants, 2011).

1,1-diphenyl-2-picrylhydrazyl (DPPH) is one of the most effective, reactive, reliable, simple and reproducible in vitro method that evaluates the free radical scavenging ability of various materials by the degree of discoloration of 1,1-diphenyl-2-picrylhydrazyl (Ibrahim et al., 2013). The degree of reduction in absorbance is reflective of the radical scavenging (antioxidant) power of the compounds (Agbafor et al., 2011).

Previous studies have made use of calamansi peels and juice in investigating for antioxidant properties. However, only a few studies have been done regarding the antioxidant properties of the calamansi crude oil and essential oil, and no studies have been made regarding their antiangiogenic properties. With the abundance of calamansi fruit and the increasing prices of synthetic antiangiogenic drugs in the Philippines, it is about time that we explore our native plants.

Study Objectives. The purpose of this study was to create directly comparable, quantitative antiangiogenic and antioxidant data, and general data for calamansi oils in which little information exists. It also specifically determined the chemical and structural properties, as well as the component organic compounds in calamansi distilled essential oil and amber crude oil.

METHOD

The study utilized experimental methods and post test control group design. Ethanolic extract of the peelings was used as antiangiogenic and antioxidant experimental drug with normal saline solution (NSS) as the negative control for antiangiogenesis and ascorbic acid as the positive control for antioxidation. For the antiangiogenic and antioxidant assays, the study utilized purposive sampling by obtaining results from different dilutions of the Calamansi peel ethanolic extract. For the plant material Calamansi fruits, the study used the non-probability, purposive sampling since the researchers intentionally gathered the plant samples from Kapalong, Davao del Norte.

The plant material calamansi fruits were collected from Kapalong, Davao del Norte, Philippines, and authenticated by the Botany Department official curators of the Philippine National Museum.

The chicken eggs were taken from Phase II, S.I.R., Matina, Davao City. The experiment was conducted at the University of Immaculate Conception (UIC) from August to December 2012.

This study was experimental in nature and made use of a posttest control group design. The commercially prepared calamansi distilled essential oil and amber crude oil served as the experimental drugs and the Bevacizumab served as the positive control for the antiangiogenic property. Ascorbic acid was used as the positive control and ethanol as the negative control for the antioxidant property, and they are the basis for the results.

Sampling technique

The study made use of non-probability purposive sampling and random sampling. Purposive sampling was used for the calamansi distilled essential oil and amber crude oil since these were taken from Maa, Davao City. Also, purposive sampling was used for the reason that assay results were obtained from the different concentrations of calamansi distilled essential oil and amber crude oil. Furthermore, the eggs used were fertilized duck eggs of the same size while the female nulliparous nonpregnant mice used were of the same weight. Random sampling was employed for the acquisition and introduction of treatments into the fertilized duck eggs and female mice. Additionally, the animal aspect of the study including sampling and bioassay procedures were referred to UIC Institutional Animal Committee Use and Care of Animals (IACUC).

The study was limited to the evaluation of the antiangiogenic and antioxidant properties of calamansi distilled essential oil and amber crude oil. The duck chorioallantoic membrane (CAM) assay was used to determine the antiangiogenic activity of the calamansi oils and Bevacizumab at 100% concentration. To determine the antiangiogenic activity, the data from the calamansi oils were compared to the data from the positive control, Bevacizumab. The effects were evaluated in terms of the growth of blood vessels in terms of number of branches. For antioxidant activity, the data from the same test solutions were compared to the data obtained from the positive control, ascorbic acid. The effects were measured in terms of percent antioxidant activity. For acute toxicity testing, different doses of the calamansi crude and essential oils were administered to the

mice, which were observed for 14 days to assess for death and toxic responses.

The calamansi distilled essential oil and amber crude oils were donated by a registered manufacturer from Maa, Davao City. The 2-day old duck eggs were bought and selected at Boulevard, Davao City. The duck eggs were kept in a thermostat-controlled incubator and stored in the researcher's home. The nulliparous and nonpregnant female mice utilized in the acute toxicity testing were bought at the Department of Health in Davao City. These were kept in the animal house of UIC Main campus, Father Selga St., Davao City. Experimentation of the duck eggs and mice were conducted in the animal house and laboratories of the UIC within the school year2014-2015.

Fourier Transform Infrared (FTIR) spectroscopy analysis of calamansi oils

The calamansi distilled and essential oils were subjected to FTIR analysis for the identification of functional groups present. A Fourier Transform Infrared Spectrophotometer was used and it was done at the Chemistry Analytical and Research Laboratory (CARL) of the Ateneo De Davao University (ADDU) in Davao City.

Gas Chromatography - Mass Spectrometric (GC-MS) analysis of calamansi oils

The calamansi distilled and essential oils were subjected to GC-MS analysis to identify and determine the amount of substances present in the oils. The calamansi oil was analyzed using SHIMADZU GCMS-QP2010 Ultra at the ADDU Chemistry Analytical and Research Laboratory, Davao City.

Determination of acute oral toxicity (OECD Guidelines 423)

Selection of animal species. The OECD Guidelines states that in the determination of acute oral toxicity, rodents are the preferred animals to be used. Normally females are used. This is because literature surveys of conventional tests show that, although there is little difference in sensitivity between the sexes, in those cases where differences are observed, females are generally slightly more sensitive. Nulliparous and nonpregnant female Swiss mice about 8 to 12 weeks old were utilized. Each of these female mice wereweighed to make sure they are of the same weight (OECD, 2001).

Preparation of animals. In accordance with the OECD guidelines 423, the animals were kept in separate but identical cages for at least 5 days prior to dosing to allow for acclimatization to the laboratory conditions (OECD, 2001).

Housing and feeding conditions. Following the OECD Guidelines 423, the temperature in the experimental animal room was 22°C (± 3°C). Humidity was at least 30% not exceeding 70%. Lighting was artificial, the sequence being 12 hours light, 12 hours dark. Conventional laboratory diets with an unlimited supply of drinking water was used for feeding. Animals may be group-caged by dose, but the number of animals per cage must not interfere with clear observations of each animal (OECD, 2001).

Administration of doses. Animals were fasted prior to dosing. This means food but not water was withheld for 3-4 hours. Following the period of fasting, the animals were weighed and the test substances, Calamansi *(Citrus microcarpa)* distilled essential oil and amber crude oil, administered through an oral gavage. After administering the test substances, food was withheld for another 1-2 hours (OECD, 2001).

Number of animals and dose level. For animal welfare reasons, it is recommended to use the starting dose of 300 mg/kg body weight for three (3) test animals. When available information suggests that mortality is unlikely at the highest starting dose level (2000 mg/kg body weight), a limit test should be conducted (OECD, 2001).

Observation. The test animals were observed individually after dosing at least once during the first 30 minutes, periodically during the first 24 hours, with special attention given during the first 4 hours, and daily thereafter, for a total of 14 days, except where they need to be removed from the study and humanely killed for animal welfare reasons or are found dead. The duration of observation were not fixed rigidly and were determined by the toxic reactions, time of onset and length of recovery period, observation may be extended when considered necessary. All observations were systematically recorded with individual records being maintained for each animal (OECD, 2001).

Duck CAM assay. Fertilized duck eggs were placed in an incubator and kept under constant humidity at 37°C. On Day 3, a square window was opened on the snub side of the shell. At two-thirds of the height from the pointed side, the eggs were traced with a scalpel and after that the shells removed with forceps. Before that, 3 mL of albumen was removed from a hole on the pointed side to detach the CAM from the shell. The window was sealed with a sterile tape and incubated until the day of experiment (Ribatti et al., 2000). This procedure

allows for the development of the intact, non-injured CAM, which becomes accessible between Day 8 and Day 9 through a window cut in the egg shell. The filter papers soaked with the different Calamansi distilled essential oil and crude oil concentrations were prepared. The filter disks were cut from Whatman paper. On the eighth day of incubation, the sterile tape was removed and the prepared filter papers wereplaced on the CAM in an avascular area. Following disk application, the window in the egg shell was closed with a piece of tape or glass and the eggs placed back into the incubator. Quantitation was performed 3 days after implantation and this involves counting the number of CAM vessels in the area of filter disk (Deryugina et al., 2009).

Determination of IC_{50}. The Median Inhibitory Concentration of Calamansi Distilled Essential Oil and Amber Crude Oil were determined from the values of percent free radical scavenging activity and concentration of both Calamansi oils using the non-linear regression analysis.

DPPH Assay. The ability of oil to scavenge free radicals was assayed with the use of a synthetic free radical compound 1, 2-diphenyl-2-picrylhydrazyl (DPPH), based on the studies of Jothy et al. (2011) and Kedare and Singh (2011). Briefly, a volume of 500 µl of each sample was mixed with 500 µl ethanol and 125 µl DPPH (0.02%) in 99.5% ethanol. The mixture was shaken vigorously and incubated in the dark. After 60 minutes, the absorbance was measured at 517 nm using a spectrophotometer (Kadri et al., 2011). A negative control was made by adding Ethanol instead of the test solutions. Ascorbic acid was used as positive control. The experiment was done in nine replicates.

The percentage of the DPPH free radical effect (antioxidant activity) was calculated using the following equation:

$$\text{DPPH scavenging effect (\%)} = [(A_0-A_1)/A_0] \times 100$$

This is where A0 is the absorbance of the control (DPPH radical + ethanol) and A1 is the absorbance in the presence of the test substances (DPPH radical + test substances) (Jothy et al., 2011).

Ethical Considerations

In acute toxicity testing using experimental animals, moribund animals or animals that are obviously in pain or showing signs of severe and enduring distress shall be humanely killed, and are considered in the interpretation of the test results in the same way as animals that died on test (OECD, 2001). On this basis, after the experiment, the chicken embryos used in the CAM assay, were killed by cutting the vessels running from the chorioallantoic membrane to the embryo. This lead to an immediate volume deficiency shock and the embryos died quickly (BioPro, 2010).

Statistical Analysis

The One-Way Analysis of Variance (ANOVA) was used to determine if there was a significant difference in the growth of the primary, secondary and tertiary blood vessels among the treatments for the antiangiogenic activity. Aside from that, it was also used to determine if there was a significant difference in the series of concentrations of both calamansi oils in terms of free radical scavenging activity of both calamansi oils and ascorbic acid, for anti-oxidant assay.

The Post Hoc Multiple Comparison Test (Tukey HSD) was used in conjunction with the ANOVA to find the means which were significantly different from each other.

RESULTS

Fourier Transform Infrared (FTIR) Spectroscopy

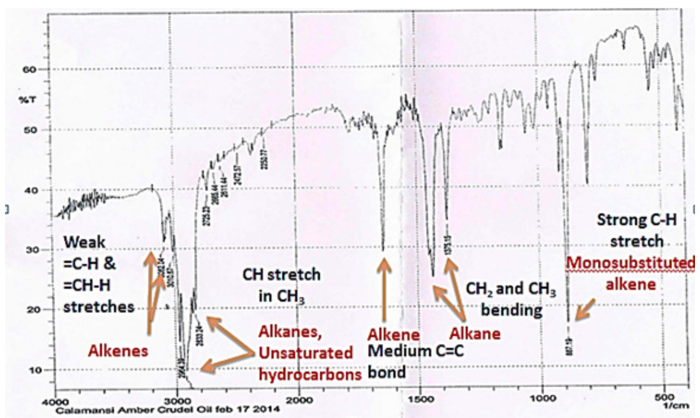

Figure 1. FTIR spectrum of calamansi amber crude oil

From the results (figure 1), it could be inferred that the amber crude oil exhibits a strong peak at 887.19 cm^{-1} as an olefinic carbon hydrogen stretch indicative of a monosubstituted alkene. Two alkane peaks which are attributed by the bending absorption of the methylene (CH_2) and methyl (CH_3) groups appear at 1375.15 and 1450 cm^{-1}. The medium peak at 1650 cm^{-1} indicates the C=C bond, while the strong peaks at 2833.24 cm^{-1}, 2920.03 cm^{-1} and 2964.39 cm^{-1} indicates the presence of CH stretch in CH_3. The former is suggestive of the alkene group and the latter of which pertains to the existence of alkanes and unsaturated hydrocarbons. Moreover, the weak peaks at 3010.67 cm^{-1} and 3082.04 cm^{-1} are typical of the =C-H and =CH-H stretches and indicative of alkenes.

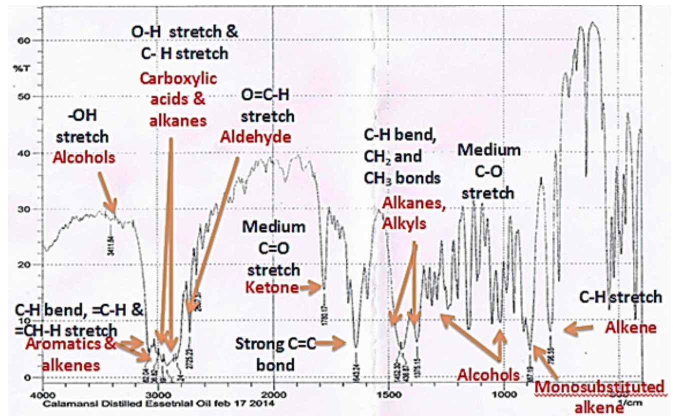

Figure 2. FTIR spectrum of calamansi distilled essential oil

In the results (figure 2), a carbon hydrogen stretch is present at peak 796.55 cm^{-1} which is suggestive of an alkene. The medium peaks between 1050 cm^{-1} and 1250 cm^{-1} showing the C-O stretch is indicative of alcohols, while the peak at 887.19 cm^{-1} is indicative of a monosubstituted alkene. The C-H bend, CH_2 and CH_3 bonds at peaks 1375.15 cm^{-1}, 1436.87 cm^{-1} and 1452.3 cm^{-1} are indicative of alkanes and alkyls. The strong peak at 1643.24 cm^{-1} indicates the presence of carbon-carbon double bond due to the alkenyl C=C stretch. The peak at 1780.17 cm^{-1} reveals the appearance of a medium peak typical of the C=O stretch of a ketone. The O=C-H stretching at peak 2725.23 cm^{-1} is suggestive of the aldehyde group. The O-H stretch and C-H stretching at peaks 2833.24 cm^{-1} 2920.03 cm^{-1} and 2964.39 cm^{-1} are indicative of carboxylic acids and alkanes. The peaks at 3006.82 cm^{-1} and 3082.04 cm^{-1} are typical of the C-H bending, =C-H and =CH-

H stretches and indicative of aromatics and alkenes. Lastly, the –OH stretch at 3411.84 cm^{-1} indicates the presence of alcohols.

Gas Chromatography - Mass Spectrometry (GC-MS)

Table 1. Identified compounds in the calamansi amber crude oil by GC-MS

Peak No.	Retention time (min)	Component Identification through Mass Spectrum Search in Data Library	Formula
	Alcohols		
9	9.83	1-Octanol (CAS) Octilin	C8H18O
11	10.49	Linalool	C10H18O
13	11	trans-p-Mentha-2,8-dienol	C10H16O
16	12.23	1,8-menthadien-4-ol	C10H16O
17	12.41	trans-p-Mentha-1(7),8-dien-2-ol	C10H16O
19,21	12.675 and 13.04	cis-Carveol	C10H16O
22,33	13.305 and 15.585	trans-Carveol	C10H16O
27	14.45	p-Mentha-1(7),8(10)-dien-9-ol	C10H16O
28	14.625	Perilla alcohol	C10H16O
32	15.445	1,2-Cyclohexanediol,1-methyl-4-(1-methylethenyl)-	C10H18O2
36,37	16.55 and 17.235	8-Hydroxylinalool	C10H18O2
39	19.02	Hedycaryol	C15H26O
41,43	19.545 and 20.31	Spathulenol	C15H24O
46	20.765	.beta.-Eudesmol	C15H26O
47	21.285	.beta.-copaen-4.alpha.-ol	C15H24O
	Ester		
35	16	Neryl Acetate	C12H20O2
	Hydrocarbons		
2	7.61	Sabinene	C10H16
3	7.735	beta.-Pinene	C10H16
4	7.965	beta.-Myrcene	C10H16
6	8.46	DELTA.3-Carene	C10H16
7	8.81	m-Cymene	C10H14
8	9	D-Limonene	C10H16
18	12.605	Santolinatriene	C10H16
38	18.125	.beta.-Selinene	C15H24
44	20.44	(-)-Aristolene	C15H24
	Ketones		
23	13.545	(-)-(R)-Carvone	C10H14O
24	14.05	p-Mentha-1,8-dien-3-one	C10H14O
	Aldehydes		
5	8.26	Octanal (CAS) n-Octanal	C8H16O
12	10.59	Nonanal	C9H18O
20	12.745	Decanal (CAS) n-Decanal	C10H20O
25	14.18	p-Mentha-1,8-dien-7-al	C10H14O
	Oxides		
1	7.09	Hydroperoxide, 1-methylpentyl	C6H14O2
14,15	11.25 and 11.34	Limonene oxide	C10H16O
26	14.38	Limonene dioxide	C10H16O2
29,30	14.735 and 14.99	(1R,4R)-p-Mentha-2,8-diene, 1-hydroperoxide	C10H16O2
31	15.21	p-mentha-1,8-dien-4-hydroperoxide	C10H16O2
34	15.695	(2R,4R)-p-Mentha-6,8-diene, 2-hydroperoxide	C10H16O2
	Others		
48	23.785	Platambin	C15H26O2

The constituents identified in the calamansi amber crude oil were grouped into alcohols, aldehydes, ester, hydrocarbons, ketones, oxides and others (table 1). Majority of the constituents found were terpenes, specifically, monoterpenes and sesquiterpenes. About 22 oxygenated terpenes (13 alcohols, 1, aldehyde, 1 ester, 2 ketones and 5 oxides) and 8 hydrocarbon terpenes were recognized.

Table 2. Identified compounds in the calamansi distilled essential oil by GC-MS

Peak No.	Retention time (min)	Component Identification through Mass Spectrum Search in Data Library	Formula
	Alcohols		
10	10.495	Linalool	C10H18O
12	10.775	Farnesol	C15H26
13	11.005	trans-p-Mentha-2,8-dienol	C10H16O
16,36	11.6 and 26.945	beta.-Terpineol	C10H18O
17	12.23	1,8-menthadien-4-ol	C10H16O
18	12.415	Cyclohexanol,,2-Methylen-5-Isopropenyl-	C10H16O

20,21	12.675 and 13.04	cis-Carveol	C10H16O
22	13.305	trans-Carveol	C10H16O
25	14.995	p-Mentha-E-2,8(9)-dien-1-ol	C10H16O
27	15.445	1,2-Cyclohexanediol,1-methyl-4-(1-methylethenyl)-	C10H18O2
29	16.005	trans-p-Mentha-1(7),8-dien-2-ol	C10H16O
30,31	16.545 and 17.24	8-Hydroxylinalool	C10H18O2
	Aldehydes		
5	8.265	Octanal	C8H16O
11	10.59	Nonanal	C9H18O
	Hydrocarbons		
2	7.61	Sabinene	C10H16
3	7.735	beta.-Pinene	C10H16
4	7.97	beta.-Myrcene	C10H16
6	8.465	DELTA.3-Carene	C10H16
7	8.81	m-Cymene	C10H14
8	9.005	D-Limonene	C10H16
19	12.6	Santolinatriene	C10H16
32,33	17.47 and 18.15	7-Oxabicyclo[4.1.0]heptane, 1-methyl-4-(2-methyloxiranyl)-	C10H16O2
	Ketones		
23	13.55	(-)-(R)-Carvone	C10H14O
	Oxides		
1	7.09	Hydroperoxide, 1-methylpentyl	C6H14O2
14,15	11.25 and 11.34	Limonene oxide	C10H16O
24	14.74	(1S,4R)-p-Mentha-2,8-diene, 1-hydroperoxide	C10H16O2
26	15.215	p-mentha-1,8-dien-4-hydroperoxide	C10H16O2
28	15.695	(2R,4R)-p-Mentha-6,8-diene, 2-hydroperoxide	C10H16O2
34	25.995	Caryophyllene oxide	C15H24O

The constituents identified in the calamansi distilled essential oil were grouped into alcohols, aldehydes, hydrocarbons, ketones and oxides (table 2). Majority of the constituents found were terpenes, specifically, monoterpenes and sesquiterpenes. Analysis revealed 16 oxygenated terpenes (10 alcohols, 1 ketone and 5 oxides) and 6 hydrocarbon terpenes.

GC-MS analysis was also able to quantify the limonene content of both calamansi oils. Results showed that the Calamansi amber crude oil contained 71.85% limonene, whereas the calamansi distilled essential oil contained 80.39% limonene.

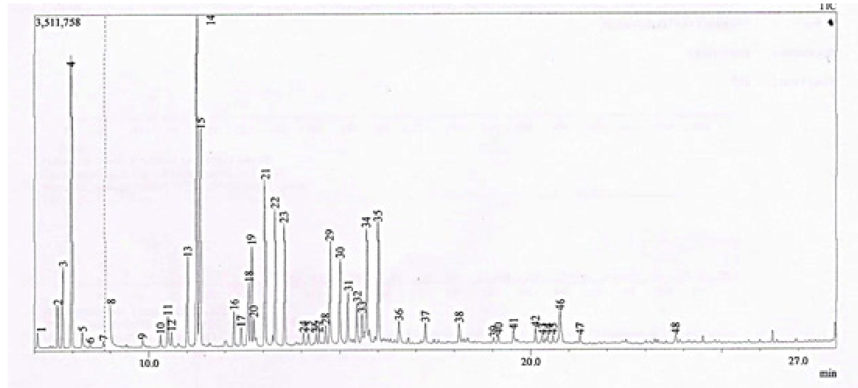

Figure 3. Chromatogram of the peaks identified in the calamansi amber crude oil

The top 5 most abundant peaks in the chromatogram for the Calamansi Amber Crude Oil were peak numbers 14, 4, 15, 21 and 22 (figure 3). The highest of which is the limonene oxide, followed by the beta-myrcene, more of the limonene oxide, cis-carveol and trans-carveol.

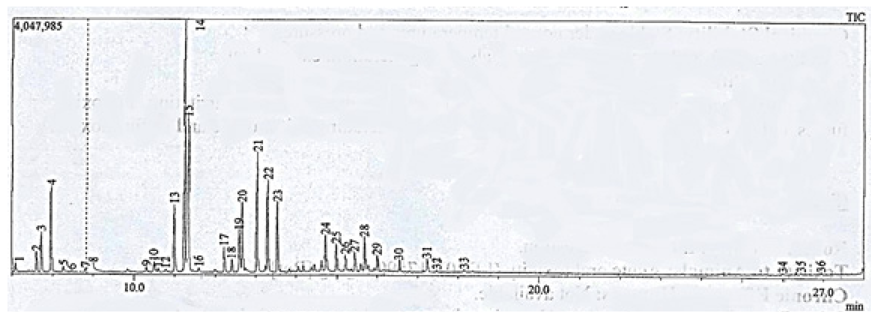

Figure 4. Chromatogram of the peaks identified in the calamansi distilled essential oil

The top 5 peaks in the chromatogram of the calamansi distilled essential oil were 14, 15, 21, 22 and 4 (figure 4). The highest peaks at 14 and 15 pertain to limonene oxide, followed by cis-carveol, transcarveol and beta-myrcene.

Acute oral toxicity results (OECD 423)

Results show that the acute oral toxicity dose of both calamansi oils is within the toxicity range of 2000 mg/kg to 5000 mg/kg, under the category 5 of the Globally Harmonized System. Both calamansi amber crude oil and distilled essential oil can be classified as non-toxic materials that can be used in products for oral administration.

Median inhibitory concentration (IC_{50}) determination

Probit y analysis was done to determine the IC_{50} of the calamansi oils. For the amber crude oil, non-linear regression computation showed that the equation obtained from the line was $y = 0.0804\ln(x) + 1.001$, where x is the concentration of the amber crude oil and y is the equivalent probit y value of the % free radical scavenging activity. Based on the given equation, the IC_{50} of the amber crude oil was at 55.87%.

On the other hand, non-linear regression computation for the distilled essential oil, showed that the equation obtained from the line was $y = 0.3714\ln(x) + 1.0148$, where x is the concentration of the distilled essential oil and y is the equivalent probit y value of the % free radical scavenging activity. Based on the equation given, the IC_{50} of the distilled essential was at 26%.

Antiangiogenic activity

Table 3. Difference in antiangiogenic activities of the calamansi amber crude oil, distilled essential oil and bevacizumab by CAM assay in the primary blood vessels

Treatment	N	Mean	Std. Deviation	F	p-value	Remarks
Crude	9	3.3640	2.18785	.110	.896	Not Significant
Essential	9	3.0980	1.02812			
Bevacizumab	9	3.0697	.79803			

*Calculation was performed at the .05 level of significance

Comparison in the mean primary blood vessel was observed between the groups (table 3). The result shows that the p-value generated is greater than the .05 level of significance ($F = .110$, $p > .05$). This means that there is no significant difference in the mean primary blood vessels among the groups.

Table 4. Difference in antiangiogenic activities of the calamansi amber crude oil, distilled essential oil and bevacizumab by CAM assay in the secondary blood vessels

Treatment	N	Mean	Std. Deviation	F	p-value	Remarks
Crude	9	20.0847	9.00625	2.140	.140	Not Significant
Essential	9	15.8162	7.46961			
Bevacizumab	9	13.1928	3.97281			

*Calculation was performed at the .05 level of significance

The mean secondary blood vessels was also compared between the groups (table 4). The result shows that the p-value generated is greater than .05 level of significance ($F = 2.140$, $p > .05$). This means that there is no significant difference in the mean secondary blood vessels among the groups. In other words, the antiangiogenic activity of the calamansi crude oil, essential oil and bevacizumab in the secondary blood vessels are most likely the same.

Table 5. Difference in the antiangiogenic activities of the calamansi amber crude oil, distilled essential oil and bevacizumab by CAM assay in the tertiary blood vessels

Treatment	N	Mean	Std. Deviation	F	p-value	Remarks
Crude	9	74.5771	33.97390	4.863	.017	Significant
Essential	9	70.2437	20.36368			
Bevacizumab	9	41.1171	16.42098			

*Calculation was performed at the .05 level of significance

Comparison of the mean tertiary blood vessels between the groups was also observed (table 5). The result shows that the p-value generated is less than .05 level of significance (F = 4.863, p < .05). This means that there a significant difference in the mean values of tertiary blood vessels of calamansi crude oil, essential oil and Bevacizumab.

Table 6. Post hoc multiple comparison test using Tukey HSD

(I) groups	(J) groups	Mean Difference (I-J)	Std. Error	p-value
Crude	Essential	4.33345	11.67001	.927
	Bevacizumab	33.46000*	11.67001	.022
Essential	Crude	-4.33345	11.67001	.927
	Bevacizumab	29.12655	11.67001	.050
Bevacizumab	Crude	-33.46000*	11.67001	.022
	Essential	-29.12655	11.67001	.050

Meanwhile, the Tukey test was used to observe pairwise comparisons (table 6). Hence, it revealed that the p-value generated between Bevacizumab and crude oil, and Bevacizumab and essential oil were less than the .05 level of significance.

Upon comparison of the positive control (bevacizumab) to the crude oil, it showed that there was a significant difference between the two (p <.05). This suggested that the Bevacizumab showed higher antiangiogenic activity than the crude oil. Similarly, there was also a significant difference between the positive control (bevacizumab) and the essential oil (p <.05) which indicated that the positive control showed higher antiangiogenic activity than the essential oil. In contrast, there was no significant difference between the crude oil and essential oil (p >.05). This shows that the antiangiogenic effects between these two oils are more likely to be the same.

Antioxidant Activity

The antioxidant property of Calamansi *Citrus microcarpa* crude and essential oils were evaluated through their ability to donate an electron or hydrogen atom to the free radical, DPPH. The DPPH reacted with the Calamansi oils by pairing with the electrons leading to gradual loss of the DPPH's violet color. The decrease

in absorbance was measured after an hour by a UV-VIS spectrometer at 517 nm and compared with that of the standard, ascorbic acid.

Table 7. Difference in the antioxidant activities of the calamansi amber crude oil, distilled essential oil and bevacizumab by DPPH assay

Treatment	N	Mean	Std. Deviation	Std. Error	F	p-value	Remarks
Essential	9	91.7367	.70739	.23580	712.461	.000	Significant
Crude	9	99.0056	.52044	.13872			
Ascorbic	9	100.0000	.00000	.00000			

*Calculation was performed at the .05 level of significance

It was found that the essential oil had a 91.74%, the crude oil had 99.01% and the ascorbic acid had a 100% free radical scavenging activity at the 100% concentration (table 7). The result also showed that the p-value generated was less than the .05 level of significance (F = 712.461, p <.05). This means that there is a significant difference in the mean free radical scavenging activity among the groups.

To determine which among the three treatments posted the greatest antioxidant activity, further statistical test was conducted using Post Hoc Tukey HSD test.

Table 8. Post hoc multiple comparison test using Tukey HSD

(I) groups	(J) groups	Mean Difference (I-J)	Std. Error	p-value
Essential	Crude	-7.26889*	.23902	.000
	Ascorbic	-8.26333*	.23902	.000
Crude	Essential	7.26889*	.23902	.000
	Ascorbic	-.99444*	.23902	.001
Ascorbic	Essential	8.26333*	.23902	.000
	Crude	.99444*	.23902	.001

The Tukey test revealed that the p-value generated between Ascorbic acid and crude oil, and Ascorbic acid and essential oil were less than the .05 level of significance (table 8).

Upon comparison of the positive control (Ascorbic acid) to the essential oil, it showed that there was a significant difference between the two ($p < .05$). This suggested that the Ascorbic acid showed higher antioxidant activity than the essential oil. Similarly, there was a significant difference between the positive control (ascorbic) and the crude oil ($p < .05$) which indicated that the positive control showed higher antioxidant activity than the crude oil. Moreover, there was also a significant difference between the crude oil and essential oil ($p < .05$) indicating that the crude oil has higher antioxidant activity than the essential oil.

DISCUSSION

This study investigated the chemical, antiangiogenic and antioxidant properties of calamansi amber crude oil and distilled essential oil. In summary, terpenes dominate the chemical constituents of both the crude and the distilled essential oils. Both oils exhibit high free radical scavenging activities making them good antioxidants. Also, both oils exhibit antiangiogenic potential, though the effect was not as high as that of the positive control Bevacizumab.

The results of the antiangiogenesis experiments is supported by the study findings of Hussain et al. (2011), who observed that there was just thinning in the primary and secondary blood vessels of the Diclofenac Sodium-treated CAM. And, as revealed in the studies of Zhang et al. (2014) and Arjaans et al. (2013), it was found that Bevacizumab caused an inhibition of angiogenesis and promoted the normalization of blood vessels. Consistent to these, the results of this study showed little differences as to the number of blood vessels left in the primary and secondary blood vessels of the groups treated with Calamansi oils and Bevacizumab.

Also, from the results, it can be deduced that the positive control showed higher antiangiogenic activity than both the Calamansi crude and essential oils. However, it can also be reasoned that both the Calamansi crude and essential oils have antiangiogenic activities, though not as comparable to the Bevacizumab. In a study by Jadhav et al. (2011), they found out that there was reduced neovascularization in the tertiary blood vessels of the Boerhaaviadiffusa alcohol extract though not as high as that of the acetoneextract. The findings of Hussain

et al. (2011) also showed fading in the tertiary blood vessels by the diclofenac sodium in the CAM assay. Additionally, in the study of Chrisnanto et al. (2008) regarding a citrus, specifically *Citrus reticulata* peel, they found that it had an antiangiogenic effect as seen in its ability to hinder new blood vessel formation in the microscopic analysis.

With regard to organic compound constituents, the results of this study showed high presence of terpenes and terpenoids in both calamansi oils, specifically the monoterpenes and sesquiterpenes which inhibit tumor cell proliferation (Yang et al., 2010). The antiangiogenic activities of the oils could therefore be attributed to the presence of these compounds in the oils. This is supported by the findings of Patilet. al. (2012) which showed that the oils isolated from *Citrus aurantifolia* and *Citrus senesis* (rich in D-limonene, a monoterpene) were capable of inhibiting proliferation of human colon cancer cells by inhibition of angiogenesis.

Regarding the antioxidant activity, though there was a significant difference among the crude and essential oils and ascorbic acid, in favour of positive control ascorbic acid, the findings still clearly indicate that the calamansi crude and essential oils reduced the concentration of the DPPH radical with an efficacy near to that of the standard antioxidant. Both calamansi crude and essential oils were able to reduce the stable, purple-colored radical DPPH into a yellow-colored DPPH. As cited by Anisah et al. (2008) in their study regarding three citrus species (*C. microcarpa, C. aurantifolia* and *C. hystrix*), the *C. microcarpa* or calamansi exhibited the highest antioxidant activity.

Additionally, another study by Roowi (2008) regarding six citrus essential oils, one of which was *C. microcarpa*, also revealed a very high radical-scavenging activity of *C. microcarpa* against the DPPH radical. Furthermore, in the study of Dai et al. (2013), it was found that limonene showed higher free radical scavenging activity than the W. prostate essential oil, whose main components were limonene and pinene. As supported by the said study, the current results show that much of the antioxidant activity of the calamansi oils can be attributed to the activity of limonene in the oils.

On the whole, as calamansi can easily be grown and cultivated in the country climate, the findings indicate industry potential for the plant as source of active constituents for dietary and drug supplement development.

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International Journal of Education Research for Higher Learning *Print ISSN 1656-0604*
Vol. 22 No. 2 October 2016 *Online ISSN 2244-6532*

***Ficus septica Burm.*: Pre-Evaluation on its Secondary Metabolites and Mutagenic Activity Using Solvents of Different Polarities**

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ABSTRACT

Mutagenicity testing is one of the important tests to determine the potential of a drug candidate to induce carcinogenesis. Aside from efficacy, equally important parameter during drug testing is its safety. To meet the guidelines of Food and Drug Administration (FDA) prior to the formulation, a pre-evaluation of the mutagenic property of Lagnub *(Ficus septica)* was investigated. The fresh and dried leaf extract of Lagnub was used in this study. Initially, a phytochemical screening was conducted followed by spectroscopic analysis using FTIR and UV-Vis. Mutagenicity testing was done using the Ames test (direct) using different solvents and concentrations while heavy metal analysis for lead and cadmium was performed using atomic absorption spectrometry. The Chi-Square test was used for statistical analysis. Results show carbohydrates, amino acids and flavonoids are present in the plant material. Fourier-Transform Infrared spectroscopy (FTIR) analysis identified the presence of alcohol, carboxylic acids, alkanes and alkynes while UV-Vis spectroscopy showed the presence of the carbonyl functional group. Mutagenicity testing show that at 100% concentration, the aqueous, ethanolic, and hydro-ethanolic solvents for the two extracts were mutagenic using acridin as the positive control while only 100% ethanolic extract was mutagenic using benzene as positive control. For concentrations 50% and below, all solvents were not found to be mutagenic for both extracts. For heavy metal analysis, the control of cadmium and lead were not detected. The mutagenic potential of *F. septica* depends on the concentration of the plant extract. Potential dosage forms must be carefully evaluated prior to formulation.

KEYWORDS: Ames test, *Ficus septica Burm.*, secondary metabolites

INTRODUCTION

Primarily, plants have served a reservoir of potential new drugs yet only small portion of the approximately 270,000 known plants have been investigated for medicinal activity. Amidst the modern technology, 80% of the people worldwide still rely on herbal medicines as part of their primary health care (Akintowa et al., 2009). However, majority of the consumers were not considering the potential health risk of the use of medicine. Instead, they just look into the economic benefit that it may offer. One potential health risk studied in Belgium by Nortier et al., (2000) was the urothelial carcinoma associated with the use of Chinese herb *(Aristolochia fangchi)* incorporated in the weight-reducing pills. This was due to manufacturer error, which the herb was inadvertently added to the pill that contained nephrotoxic and carcinogenic effects to the patients.

The process and time course from drug discovery to approval for marketing can be lengthy and tedious (Ansel et al., 2011). Registration of pharmaceuticals requires a comprehensive assessment of their genotoxic potential. Extensive reviews have shown that many compounds that are mutagenic in the bacterial reverse mutation (Ames) test are rodent carcinogens. One such test among many others to be carefully undertaken in drug development is the mutagenicity test. As with any pharmaceutical production, evaluation of toxicity, mutagenicity and other hazards should always be linked to the efficacy that enables consumers to weigh the benefits versus risks (Rao et al., 2004).

This study had investigated *Ficus septica*, locally known as "lagnub", that is used by Ata Matigsalog tribe (Davao Region) in treating skin infections. This claim had been supported by Vital et al., (2010) in which it exhibits antibacterial and antifungal even antiprotozoal and cytotoxic activities. Prior to drug formulation, safety and efficacy can be done hence, this study primarily focused on its secondary metabolites and mutagenic activity in different concentrations using solvents of different polarities.

METHOD

The study utilized an experimental design. This was carried out using the crude extracts from dried and fresh leaves of Lagnub *(Ficus septica Burm.)* in determining the secondary metabolites through manual experimentation of phytochemical screening and detection of functional groups through spectroscopic analysis through Fourier Transform Infrared Spectroscopy (FTIR) and Ultraviolet Visible Spectroscopy

(UV-Vis) The analysis was using different polarities (distilled water, ethanol, and hydroethanolic solvents) and concentrations of 100%, 75%, 50% and 20%, respectively. Presence of heavy metals (cadmium and lead) were also analyzed using Graphite Furnace-Atomic Absorption Spectrophotometry (GFAAS). In the mutagenic activity, Direct Ames test was employed using Salmonella typhimuriumTA98 only having two trials and three replicates only. The microorganism was obtained from Philippine National Culture of Microorganisms, UP BIOTECH. The entire study commenced in June of 2013 and finished in January 2014.

A. Preparation and Extraction of Fresh and Dried Leaves

Two hundred (200) grams of fresh Lagnub *(Ficus septica Burm.)* leaves were cut into small pieces and macerated in 1000 mL of 95% of ethanol. Another two hundred (200) grams were macerated with 1000 mL of distilled water, with 800 mL ether and the same amount of leaves with 1000 mL hydroethanolic (500 mL distilled water and 500 mL of 95% ethanol) in respective Erlenmeyer flasks. Similar procedure was applied for dried leaves but 80% Ethanol was used for maceration. The flasks were covered with aluminum foil for 48 hours and filtered in a Buchner funnel using a vacuum pump and the solvent was removed under vacuum using a rotary evaporator (Vital et al., 2009).

B. Phytochemical Screening for Secondary Plant Metabolites

Carbohydrates. Extracts were dissolved in 5 mL distilled water and filtered. The 1 mL of filtrate was tested with 2 drops of Molisch reagent (α- Napthol solution) in a test tube; another 1 mL filtrate was tested with 2 drops of Benedict's reagent; another 1 mL of filtrate was hydrolyzed with dilute HCI, neutralized with alkali and Fehling's reagent (Guevarra et al., 2005).

Flavonoids. Using alkaline reagent test, extracts were treated with 2-3 drops of sodium hydroxide solution. In lead acetate test, extracts were treated with 2-3 drops of lead acetate solution.

Proteins and Amino Acids. Using xanthoproetic test, extracts were treated with few drops of nitric acid. In Ninhydrin test, extract were added with 0.25% ninhydrin reagent and boiled for few minutes (Guevarra et al., 2005).

C. Fourier Transform Infrared Spectroscopy (FTIR) Sample Analysis

Fifteen (15) mL of Lagnub extract sample was lyophilized (LAB Kit SD 12MR U-Therm lyophilizer) at the Science Resource Center (SRC) in the University of the Immaculate Conception. Analysis for the presence of functional group was done using FTIR machine at Ateneo de Davao University.

D. UV-Vis Spectrophotometry Analysis

Two (2) mL of dried ethanolic Lagnub extract was added with distilled water in volumetric flask to make 100 mL and filtered afterwards. One (1) mL of the prepared solution was added with distilled water in volumetric flask to make 50 mL. Prepared sample was placed into a cuvette. Wavelength was scanned and determined the absorbance of the leaf extracts. It was presented in a spectral curve.

E. Mutagenic Activity of Lagnub Crude Extract (Ames Test-Direct)

Preparation of the Top Agar. Six (6) grams of Difco agar and five (5) grams of NaCl were dissolved to 1000 mL distilled water. The solution was mixed thoroughly, divided into 100 aliquots and autoclaved for 20 minutes at 121^{o}C (Engelhard et al., 2004).

Preparation of Base Agar. Fifteen (15) grams of Difco agar were dissolved in 1000 mL distilled water on a hot plate using a magnetic stir bar and autoclaved for 20 minutes at 121°C. Fifty (50) mL of sterile 40% glucose solution and 20 mL of Vogel-Bonner medium were added to lightly colored agar. Thirty (30) mL of the base agar was poured in each plate (Engelhardt et al., 2004) prior to the assay.

Preparation of Inoculum. One loopful of *Salmonella typhimurium* TA98 was inoculated to 5 mL Nutrient broth. The tubes were rolled between palms and incubated for 16 hours (Engelhardt et al., 2004).

Assay Proper for Direct Mutagen Testing. The mixture of two (2) mL of molten top agar together with 0.1 mL *S. typhimurium* TA98 and 0.1 mL plant

extract were poured to the base agar. Even distribution of the top agar in the plate was done. As it was hardened after an hour, the plates were incubated at 35°C for 48 hours. The visible colonies of revertant were observed (Engelhardt et al., 2004).

F. Preparation for Determination of Heavy Metals (GF-AAS-Perkin Elmer)

Fifty (50) mL of ethanolic concentration was submitted to Davao Analytical Laboratories, Inc. (DALINC) to determine the presence of cadmium (Cd) and lead (Pb) in the plant extract. A gram of the sample was prepared in a crucible and placed in a furnace for 2 hours set at 500°C, afterwards cooling was done in room temperature. Moistening of ash with 10 drops of distilled water and 4 ml of 1+1 nitric acid were done. The excess nitric acid was evaporated in a hotplate set at 100°C-120°C. Afterwards, it was placed in the furnace set at 500°C for one (1) hour then cooled in room temperature with the addition of 10 mL 1+1 hydrochloric acid. The mixture was diluted to make it 50 mL in volumetric flask with distilled water and filtration (# 42 filter paper) was done.

Statistical Treatment

In this study, descriptive and inferential statistics were used for the analysis and interpretation of the data gathered. To determine the mutagenic activities of Lagnub fresh and dried extracts using different solvents in different concentrations, descriptive statistics such as frequency counts, mean, variance, and standard deviation were determined to compute for the confidence interval values of the observed number of revertant colonies in acridine and benzene as positive controls and in water (blank) as negative control. For the analysis, if the number of revertant colonies was observed to be within the interval values of the positive controls, it was interpreted as positive, meaning, it exhibited mutagenic activity but if it is not within the interval values of the positive controls, it was interpreted as not exhibiting mutagenic activity. On the other hand, using the negative control, it was determined if the different extracts had exhibited the same with water (blank) having zero (0) number of revertant colonies.

To determine if there was a significant difference in the mutagenic activities of Lagnub fresh and dried extracts, all the frequencies interpreted as exhibiting mutagenic activities were counted for each solvent in the different concentrations and the positive and negative controls. Chi-square statistical test was used to determine if there was a statistical significance in terms of association of variables describing the mutagenic activities between the Lagnub fresh and dried extracts.

RESULTS AND DISCUSSION

Phytochemical Screening

Phytochemical screening was performed using manual experimentation and it was found that the leaf extracts contained the following metabolites, namely, carbohydrates, amino acids and flavonoids as presented in table 1.

Table 1. Phytochemical screening of *Ficus septica Burm.*

Solvents	Carbohydrate			Flavonoids		Amino acid
	Molisch test	Benedict's test	Fehling's test	Sodium hydroxide test	Lead acetate test	Ninhydrin test
Fresh aqueous extract	+	+	+	+	+	+
Dried aqueous extract	+	-	+	+	+	+
Fresh ethanolic extract	-	-	-	-	+	+
Dried ethanolic extract	+	+	+	+	+	+
Fresh ethereal extract	+	+	-	-	+	-
Dried ethereal extract	+	+	+	+	+	-

Legend: + (positive) - (negative)

Table 1 shows the positive result of the phytochemical screening, which determined the secondary metabolites namely amino acid, carbohydrates and flavonoids. This means that it conformed to the previous phytochemical study of Wu et al. (2002) and Simo et al. (2008) which report that flavonoids, alkaloids, coumarins, triterpines and amino acid were the active components of *Ficus septica Burm.* extracts.

Functional Groups and Chromophore Present

in Lagnub Fresh and Dried Leaf Extracts

FTIR Results

Table 2 presents the infrared spectroscopy result for the determination of the functional groups present in *Ficus septica.* The infrared spectrum represents a fingerprint of a sample with absorption peaks that correspond to the frequencies of vibrations between the bonds of the atoms making up the material.

Table 2. Fourier Transform Infrared Spectroscopic (FTIR) results

	Peak	Height	Corr. Height	Base (H)	Base (L)	Area	Corr. Area
1	711.68	0	58.2753	754.12	697.22	468.1349	6.6363
2	995.20	0	90.695	997.13	947.95	397.4704	1.5331
3	1041.49	0	92.8143	1043.42	1011.59	281.7049	0.7785
4	1071.38	0	91.2322	1100.31	1068.49	281.8088	0.9161
5	1128.28	0	93.8318	1168.78	1126.35	354.6318	1.4005
6	1260.39	0	91.8421	1263.29	1226.64	308.618	1.2597
7	1720.39	0	89.9139	1757.03	1719.42	250.0695	2.6571
8	2038.62	0.0005	98.1727	2041.51	1983.65	304.5241	0.4243
9	2281.63	0.0003	60.0997	2335.64	2264.27	378.4407	12.4527
10	2686.66	0	92.9743	2689.55	2360.71	2187.3586	225.9739
11	2764.77	0	98.1622	2766.7	2690.51	583.4909	1.6188
12	2829.38	0	97.7622	2831.31	2797.55	270.3696	0.0727
13	2879.52	0	97.8143	2880.49	2850.59	246.4301	0.4552
14	3083.00	0	98.7366	3083.96	3005.85	676.6237	0.5316
15	3131.22	0	93.8301	3134.11	3083.96	450.6847	0.5202
16	3200.65	0	90.3161	3206.44	3168.83	351.0412	1.3556

Table 3. FTIR spectra of Lagnub *(Ficus septica Burm.)* fresh and dried leaf

Experiment frequency (cm^{-1}) Obtained	Reference frequency (cm^{-1})	Bond present	Functional group
995.2 -1260.39	1060-1150	-C=O	Alcohols, Ethers, Carboxylic acids, Esters
1720.39	1640-1760	-C=O	Carbonyl group
2038.62 - 2281.63	2100-2260	C-H	Alkynes
2764.77 - 2879.52	2850-2960	C-H	Alkanes
3083.00 - 3131.22	2500-3000	-C=O	Carboxylic acid
3200.65	2500-3200	-OH	Hydroxyl group

Table 3 shows that the range of the experiment frequencies obtained for the functional groups: alcohol, ethers, carboxylic acids, and esters 995.2-1260.39 in cm^{-1} are within the reference frequency (1150-1060 cm^{-1}) which suggests for their presence in Lagnub *(Ficus septica Bum.)* fresh and dried extracts. Also, the experiment frequencies obtained 1720.39 cm^{-1}, 2038.62-2281.63 cm^{-1} and 2764.77-2879.52 cm^{-1} are within the reference frequencies for carbonyl group 1640-1760, alkynes 2100-2260 cm^{-1} and alkanes 2960-2850 cm^{-1}, respectively, which confirmed their presence in the extracts analyzed. However, experiment frequencies of FTIR spectra for carboxylic acid and hydroxyl group were all beyond when compared to their respective reference frequencies which failed to confirm their presence in Lagnub fresh and dried extracts.

Accordingly, hydrocarbon such as alkynes and alkanes are responsible for being mutagenic of certain plants. This means that the functional group which is responsible for exhibiting mutagenic effect are hydrocarbons that have the same mechanism of action with benzene and acridine that are very potent to cause reverse mutation.

Table 4. UV-Visible result on possible strongly absorbing chromophores in

Lagnub *(Ficus septica)* fresh and dried extracts

Test materials	Absorbance	Wavelength	Possible Organic Molecules*
Absolute alcohol and plant extract	0.582	327	Functional group: Carbonyl
Water and plant extract	0.759	291	Possible molecule: aldehyde/ketones

*Based on Owe, T. (Fundamentals of Modern UV-visible spectroscopy)

Table 4 shows that the maximum wavelength of absorption (0.759) indicates that a carbonyl is the predominant functional group in the plant material extracts and confirmed the possible presence of aldehydes or ketones. Accordingly, UV-visible spectra show only a few broad absorbance bands. UVvisible spectroscopy provides a limited amount of qualitative information because most absorption by organic compounds results from the presence of ∏ (that is unsaturated) bonds. A chromophore is a molecular group usually containing a ∏ bond. When inserted into a saturated hydrocarbon (which exhibits no UV-visible absorbance spectrum), it produces a compound with absorption between 185 and 1000nm.

Statistical Analysis of Ames Test

Determination of Solvents Used for Extraction of Lagnub *(Ficus septica Bum.)* Fresh and Dried Leaf Extracts that Exhibit Mutagenicity

The Ames test is a method that uses bacteria to test whether a given chemical can cause cancer. It is a biological assay to assess the mutagenic potential of chemical compounds. A positive test indicates that the chemical is mutagenic and, therefore, may act as a carcinogen, because cancer is often linked to a mutation. The test serves as a quick and convenient assay to estimate the carcinogenic potential of a compound because standard carcinogen assays on mice and rats are time-consuming (taking two to three years to complete) and expensive. However, false-positives and false-negatives are known.

Table 5 presents the Direct Ames test results for determination of mutagenicity of *Ficus septica* fresh and dried leaf extract using different solvents for extraction in 100%, 75%, 50%, and 25% having water (blank as a negative control) and acridine and benzene (positive controls).

Table 5. Direct Ames test of the three solvents in different concentrations of Lagnub *(Ficus septica Burm.)* fresh and dried leaf extracts using acridine and benzene (Positive Controls)

Solvents in Different Concentrations	Fresh Extract				Dried Extract			
	Acridine (62.3233 -677.6767) no. of revertants	Benzene (816.9734 -1116.236) no. of revertants	Probability Value Observed Mutagenicity Using Positive Controls		Acridine (62.3233 -677.6767) no. of revertants	Benzene (816.9734 -1116.236) no. of revertants	Probability Value Observed Mutagenicity Using Positive Controls	
			Acridine	Benzene			Acridine	Benzene
Ethanolic Solvent								
100%	++++++	---+++	1.00	0.05	++++++	+-++++	1.00	0.83
75%	------	------	0.00	0.00	------	------	0.00	0.00
50%	------	------	0.00	0.00	------	------	0.00	0.00
25%	------	------	0.00	0.00	------	------	0.00	0.00
Aqueous Solvent								
100%	++++++	------	1.00	0.00	------	------	0.00	0.00
75%	------	------	0.00	0.00	------	------	0.00	0.00
50%	------	------	0.00	0.00	------	------	0.00	0.00
25%	------	------	0.00	0.00	------	------	0.00	0.00
Hydroethanolic Solvent								
100%	++++++	------	1.00	0.00	++++++	------	0.00	0.00
75%	+++---	------	0.00	0.00	+--+++	------	0.00	0.00
50%	------	------	0.00	0.00	------	------	0.00	0.00
25%	------	------	0.00	0.00	------	------	0.00	0.00

Legend:

+ numbers of revertants observed in the Lagnub fresh and dried extracts are within the estimated interval values observed, on acridine and benzene (positive controls) at df=5 and α/2=0.05
- number of revertants observed in the Lagnub fresh and dried extracts are not within the estimated interval values observed, on acridine and benzene (positive controls) at at df=5 and α/2=0.05

Table 5 shows that all of the solvents, ethanolic, aqueous, and hydroethanolic solvents, used for extraction using 100% concentrations have exhibited positive results for mutagenicity test using Ames Direct Method with probability values of 1.00 both for Lagnub *(Ficus septica Burm.)* fresh and dried extracts when compared to the number of revertants observed in acridine (positive control). However, only ethanolic solvent in 100% concentrations exhibited a positive mutagenicity test when results were compared to the number of revertants observed in benzene (positive control) both for fresh and dried extracts of Lagnub. At 75% concentration of the solvents used, only hydroethanolic solvent exhibited positive effects of Lagnub with a probability mutagenicity values of 0.05 and 0.67 in fresh extract and dried extract respectively. All have negative results in the mutagenicity test using the 50% and 25% concentrations of the ethanolic, aqueous and hydroethanolic as solvents for the two extracts. This means that the pure concentration of *Ficus septica Burm.* exhibited mutagenic effect which have the same mechanism with the benzene and acridine which is the positive control. However at lower concentration of all different solvent polarities it does not exhibit mutagenic effect.

Table 6 presents the direct Ames Test result of the three solvents in different concentrations of the two extracts of Lagnub *(Ficus septica Burm.)* fresh and dried extracts using water (blank) as the negative control.

Table. 6 Direct Ames test of the three solvents used for extraction of Lagnub

(Ficus septica Burm.) fresh and dried extracts using water (Blank) as negative control

Solvents in Different Concentrations	Lagnub *(Ficus septica B)*, using observed number of revertants = 0 in water (blank) as negative control			
	Fresh Extract	Dried Extract	Probability Value Observed Mutagenicity Using Negative Control	
			Fresh Extract	Dried Extract
Ethanolic Solvent				
100% conc.	++++++	++++++	1.00	1.00
75% conc.	------	++++++	0.00	1.00
50% conc.	------	++++++	0.00	1.00
25% conc.	------	++++--	0.00	0.67
Aqueous Solvent				
100% conc.	++++++	------	1.00	0.00
75% conc.	------	------	0.00	0.00
50% conc.	------	------	0.00	0.00
25% conc.	------	------	0.00	0.00
Hydroethanolic Solvent				
100% conc.	++++++	+++++	1.00	1.00
75% conc.	++++++	+++++	1.00	1.00
50% conc.	++++++	+++++	1.00	1.00
25% conc.	++++++	+++++	1.00	1.00

Legend:
- \- numbers of revertants observed in the Lagnub fresh and dried extracts are the same with the estimated value observed on water (blank) as negative control which is interpreted as nonmutagenic
- \+ number of revertants observed in the Lagnub fresh and dried extracts are not the same with the estimated value observed on water (blank) as negative control which is interpreted as mutagenic.

Table 6 shows that Lagnub *(Ficus septica Burm.)* dried leaf extracts extracted

using the aqueous solvent in different concentrations, 100%, 75%, 50% and 25% have exhibited no mutagenic activities having probability values (p=1.00) for non-mutagenic activity. Mutagenic activity was only accounted in fresh extract of the plant at 100% concetrations of aqueous solvent. However, Direct Ames test result shows that the hydroethanolic solvent is positive for mutagenic activity when water (blank) was used as a negative control both in fresh and dried extracts of Lagnub using the four (4) concentrations of hydroethanolic used in this study.

Difference in Mutagenic Activities of Lagnub Fresh and Dried Leaf Extracts

Table 7 presents the Chi-square statistical test analysis showing the observed and the corresponding expected frequencies describing the mutagenic activities using acridine and benzene (positive controls) and water (blank) as negative control for Lagnub *(Ficus septica Burm.)* fresh and dried leaf extracts.

Table 7. Chi-Square test (x^2) statistical test result of the difference in mutagenic activities of Lagnub *(Ficus septica Burm.)* fresh and dried extracts

Solvents	Fresh Extract	Dried Extracts	Total
Ethanolic	15 14.8877	17 17.1123	32
Aqueous	12 13.0267	16 14.9733	28
Hydroethanolic	60 59.0856	67 67.9144	127
Total	87	100	187

Chi-square test analysis
df=4 α=0.05 = 0.178498 <x^2 critical = 9.488 Not significant

Table 7 shows that the X^2 (df = 4)=0.178498 <x^2 critical = 9.488 which means that there is no ample sample evidence that would support that there is a significant difference in the mutagenic activities of Lagnub fresh and dried extracts using the three different solvents for extraction used in this study. This suggests that although there were differences in the number of positive and negative mutagenic results observed using acridine and benzene as positive controls and water (blank) as a negative control, at 75%, 50%, and 25% concentrations, these findings do not imply that the nature of solvents are significantly associated with the type of Lagnub extracts as whether fresh or dried.

Heavy Metal Screening

Heavy metals screening was done through Graphite Furnace Atomic Absorption Spectrometry (GF-AAS), the results obtained from the test showed that the fresh ethanolic extract from Lagnub *(Ficus septica Burm.)* does not contain heavy metals namely, lead and cadmium. This means that it is negative to heavy metals, which can cause harm to humans.

Conclusion

To sum up this study, it was found that Lagnub *(Ficus septica Burm.)* contained carbohydrates, flavonoids and amino acid in fresh aqueous extract and dried ethanolic extract

The Lagnub *(Ficus septica Burm.)* contained carbohydrates, flavonoids and amino acid in fresh aqueous extract and dried ethanolic extract.

The Fourier transport infrared spectroscopy (FTIR) reading showed the functional groups present in the leaves of *F. septica Burm.*, which include alcohol, carboxylic acids, the hydroxyl group, carbonyl group, alkanes, and alkynes. The chromophore present in the plant extract is carbonyl as the functional group, which may indicate the presence of aldehydes or ketones based in the UV-Vis reading.

The mutagenicity testing, all solvents using 100% concentration, both fresh and dried extracts, exhibited positive results compared to acridine (positive control). However, in comparing with benzene (positive control), only the 100% of ethanolic solvent was mutagenic for both fresh and dried extracts. Only 75% concentration of hydroethanolic solvent gave a positive result in fresh and dried extracts, respectively. The aqueous dried extracts in all concentrations are

nonmutagenic but only mutagenic at 100% concentration in fresh extracts.

Heavy metals such as lead and cadmium were not detected in the leaf extract of *(Ficus septica Burm.)*.

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Potential Blood Glucose Lowering Activity of Formulated Freshly Prepared and Marketed Coconut Oil *(Cocos nucifera)*

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ABSTRACT

Medium chain fatty acid is a phytochemical constituent found in the coconut oil and this study focused on the blood glucose lowering potential of formulated freshly prepared and marketed coconut *(Cocos nucifera)* oil. In the acute oral toxicity dose none of the test animals died and displayed signs of toxicity after administration of the fixed doses of 300mg/kg, 2000mg/kg and 5000mg/kg of freshly prepared coconut oil. The Approximate Effective Dose (AED) showed that the potential of the plant as a hypoglycemic agent after the tested animals showed a decreased in blood glucose level after four hours of administration of freshly prepared and marketed coconut oil. Statistical analysis using two-way ANOVA is quite necessary to determine if decrease in glucose level (post induction) is significant. Tukey's Multiple Comparison test was used to determine which of the four treatments and monitoring time showed a significant decrease in glucose level of the test animals. Comparing these least significant ranges with the differences in ordered means, the researcher arrived at the conclusion that glibenclamide as positive control was significantly different from the formulated emulsion of coconut oil. It followed also that the mean value of the negative control was significantly different from the formulated emulsion of coconut oil. This implied that glibenclamide as positive control was most effective in lowering the blood glucose level of hyperglycemic-induced rabbits, followed by formulated emulsion, marketed coconut oil and lastly by the placebo.

KEYWORDS: *Cocos nucifera*, medium chain fatty acid, AED, glucose lowering activity, hyperglycemic-induced rabbits

INTRODUCTION

Coconut oil, from the plant coconut *(Cocos nucifera)*, has benefits which range from care of the hair, teeth and skin, proper digestion and metabolism, relief from stress and kidney problems, weight loss, and bone strength (Enig, 1999). Only few people know that coconut oil can manage blood glucose level of patients with diabetes mellitus (Bruce, n.d).

According to the Philippine Council for Health Research and Development, diabetes was the ninth leading cause of death from 1999 to 2002 in the Philippines and in 2005, diabetes affected one in every 25 Filipinos, gathered from a report of the National Epidemiology Center of Department of Health (DOH).

The researchers studied the blood glucose lowering potential of coconut oil and prepared an emulsion as its formulation.

The study is based on the theory that coconut oil helps in maintaining the blood glucose within a normal range (Bruce, n.d.) and this is also supported by Kabara (2000), who stated that it contains medium chain fatty acids (MCFAs) which allow the body to meet the normal blood glucose level. It has been used by various populations, mainly in the tropics, where vascular disease has been uncommon. Island populations in New Guinea, Sri Lanka, Polynesia, the Philippines and Indonesia are known to ingest from 14% to 63% of energy from coconut and its oil.

METHOD

The experimental design focused on the study of the potential of coconut oil in lowering blood glucose level. The researchers used freshly prepared coconut oil (Experimental Drugs), prosource marketed coconut oil, glibenclamide (Positive Control) and placebo (Plain Normal Saline) as the negative control.

In this study, the researchers conducted a non-probability sampling. It was a purposive sampling to ensure the purity of the sample and that no variation of the sources of the test animals (rabbits and white mice) and the plant materials occurred during experimentation. Adult healthy mice (male and female) were properly labelled with the weight of 17 to 30 grams. Healthy rabbits (male and female) as well, were properly labelled with the weight of 700 to 1000 grams (Vogel, 1997).

The oil of plant material coconut, was taken from Mintal, Davao City. The place is abundant with specified coconut trees. The economy of Mintal is largely based on agriculture with a high level of production of copra (dried coconut).

Coconut oil extraction can be done both traditional method and modern

machinery method. Pressure, heat and motion are forces that are often used to separate the coconut oil from the white coconut meat. Depending on the type of extraction method used, the coconut oil extract may be completely pure, or it may require additional refining processes.

Preparation of Freshly Prepared Coconut Oil

Meat from each coconut was grated using a coconut shredder. The grated coconut meat was placed in a clear container and was soaked in a hot tap water. It was then squeezed to produce coconut oil. The coconut milk was heated over a low flame and was stirred slowly to produce coconut oil.

Selection of Animals

Healthy rabbits from the farm of Boys Town, Maa, Davao City and white mice from the farm of Panabo City, Davao del Norte were used as test animals in the experiment. These test animals were studied from one week (1) under specified environment conditions. They were kept in an animal house at Trinidad Greenhills, Maa, Davao City, in an area with uniform temperature of twenty to thirty degrees Celsius (20-30°C) and free from disturbances.

Determination of Approximate Effective Dose

Seventy-two (72) specified white mice previously fasted from food and water for 10-12 hours. Each mouse received an oral administration of the assigned dose of hydrochlorothiazide. After inducing with hydrochlorothiazide, the mice, which were divided into four groups, each received their respective dosages, namely, the freshly prepared (first group), prosource marketed coconut oil (second group), glibenclamide (third group), and placebo (fourth group) orally. All the mice in four groups were observed and their glucose level was checked using glucometer (Bersabal et al., 2010).

Effective Dose at ED90

Ten female mice (10) were used and grouped separately. Blood glucose levels were measured before and after administration of hydrochlorothiazide (HCTZ) to test animals. The test animals received a calculated dose of marketed coconut oil. After four hours, blood glucose were measured and recorded. Then, ED90 determination was obtained by Probit Algebraic method (Bersabal et al., 2010).

Pharmacological Screening

To determine the blood glucose lowering activity of coconut oil, hydrochlorothiazide (HCTZ) was induced to increase the blood glucose level of the test animal which was the rabbit. Hydrochlorothiazide is a popular diuretic of the thiazide class that acts by inhibiting the kidney's ability to retain water. This reduced the volume of the blood, decreasing blood return to the heart and thus cardiac output was believed to lower peripheral vascular resistance. It reduced sodium re-absorption in the distal convoluted tubule. These increased the osmolarity in the lumen, causing less water to be reabsorbed by the collecting ducts. This hassled to increase urinary output. The hyperglycemic effect of hydrochlorothiazide may exacerbate Diabetes Mellitus (Duarte, 2010). The marketed coconut oil was induced to the rabbit to determine its blood glucose lowering potential.

Formulation of Emulsion

Coconut oil was mixed with acacia in a dry mortar and to it was added 87.5 mL of distilled water all at once and the mixture was emulsified. Then, added in divided portions, triturating after each addition, were a mixture of the syrup, 8.75 mL of distilled water and vanillin dissolved in alcohol. Then, finally, enough volume of distilled water was added and thoroughly mixed to make 100 mL of the solution (Remington: The Science and Practice of Pharmacy, 21st Edition).

Statistical Treatment

To determine if there was a significant decrease in the blood glucose level of the test animals with respect to monitoring time and types of treatment administered, the two-way analysis of variance (ANOVA) was utilized. This statistical treatment is necessary to determine if decrease in glucose level (post induction) among several sets of data is significant or not. Then, the Tukey's multiple comparison test further determined which among the four treatments and monitoring time really exhibited the significant decrease in glucose level among the test animals with respect to the groupings in the experimentation.

RESULTS AND DISCUSSION

OECD Acute Oral Toxicity Test

Table 1. Acute oral toxicity testing of the freshly prepared and marketed coconut oil *(Cocos nucifera)*

Dose Level, mg/kg	Test Animal number	Body Weight, kg	Administered dose, mL	Observation time 0 h	30 minutes	24 h	Results
300	M_1	0.025	0.008	Active	Active	Active	Survived
	M_2	0.030	0.010	Active	Active	Active	Survived
	M_3	0.033	0.011	Active	Active	Active	Survived
2000	M_1	0.030	0.067	Active	Active	Active	Survived
	M_2	0.03	0.067	Active	Active	Active	Survived
	M_3	0.025	0.056	Active	Active	Active	Survived
5000	M_1	0.025	0.139	Active	Active	Active	Survived
	M_2	0.030	0.167	Active	Active	Active	Survived
	M_3	0.027	0.167	Active	Active	Active	Survived

The acute oral toxicity test was conducted by grouping the test animals of a single sex (Male) in a stepwise procedure using the fixed doses of 300 and 2000 mg/kg (exceptionally 5000 mg/kg). The initial dose level was selected on the basis of a sighting study as the dose expected to produce some signs of toxicity without causing severe toxic effects or mortality to the test animals. In the procedure, 3 white mice of each dose were used. The dose administered starts at the minimum 300mg/kg and maximum dosage of 2000 mg/kg. To classify the acute oral toxicity of the plant material, subsequent administrations were done and results are presented in table 1.

Based on the recorded observations, none of the test animals died after administration of the fixed dose of freshly prepared coconut oil. In addition, none of the test animals tested displayed signs of toxicity after receiving the fixed dose level of the plant material. No signs of changes in their skin color and eyes, nausea, vomiting, salivation, tremor, convulsion, diarrhea and sleep were recorded in the 24 hours observation time period. Consequently, the plant material is classified as non-toxic.

The classification of acute oral toxicity were based from the guidelines of the Organization for Economic Co-operation and Development (OECD) stated as follows:

Very toxic, ≤ 5mg/kg body weight; toxic, >5 ≤ 50mg/kg; harmful, >50 ≤ 500mg/kg; and no label, >500 ≤ 2000mg/kg (Walum, E., Environment Health Perspectives).

The test conducted confirmed that coconut oil is a non-toxic substance. This proves the study of dietician Ray Peat, PhD who stated that there are toxic effects found in unsaturated oils but coconut oil does not have those toxic effects, since it contains more saturated oils.

Determination of Approximate Effective Dose (AED)

Table 2. AED determination of the blood glucose lowering characteristics of freshly prepared and marketed coconut oil *(Cocos nucifera)* toward hyperglycemic rabbits

Dose, mg/kg	Treatment	Glucose Level			Diff.	Results
		Baseline	Induced	Postreatment		
20.00	Freshly repared	92	140	140	0	-
	Prosource	90	141	141	0	-
	Glibenclamide	93	144	143	1.00	+
79.621	Freshly Prepared	93	144	143	1.00	+
	Prosource	93	142	141	1.00	+
	Glibenclamide	91	140	139	1.00	+
316.977	Freshly Prepared	93	142	141	1.00	+
	Prosource	92	142	141	1.00	+
	Glibenclamide	95	142	140	2.00	+
1261.91	Freshly Prepared	93	143	139	4.00	+
	Prosource	93	143	139	4.00	+
	Glibenclamide	91	141	137	4.00	+
5023.75	Freshly Prepared	92	142	135	7.00	+
	Prosource	93	142	135	7.00	+
	Glibenclamide	92	142	134	8.00	+
20,000	Freshly Prepared	94	145	135	10.00	+
	Prosource	92	143	134	9.00	+
	Glibenclamide	92	141	126	15.00	+

Legend: *Diff. = Induced – treated;
(+): There is decrease in the blood glucose level post treatment
(-): No decreased in the blood glucose level post treatment

In this experiment, the test for the determination of approximate effective dose of freshly prepared and marketed coconut oil starts at the administration of 20 mg/kg body weight of test animals. The succeeding six doses were calculated at the 0.6 logarithmic intervals. Overall results are presented in table 2.

Results of the AED determination indicates the potentiality of the plant material as hypoglycemic agent after the tested animals showed decreased on blood glucose level at four hours after administration of freshly prepared and marketed coconut oil. It further suggests that the approximate effective dose of the freshly prepared and marketed coconut oil that can effectively reduce the blood glucose level of the hyperglycemic rabbits at dose level ranges from 79.62 to 20,000 mg/kg. In this case, the researchers proceeded with the bioassay and arbitrarily selected 5023.75 mg/kg dosage which was compared to the effect of glibenclamide (positive control).

Coconut oil shows the potentiality to lower the blood glucose level of the test animals because it has medium chain fatty acids that helps of burning calories. However, glibenclamide exerts greater effect on lowering blood glucose level as presented by the data; the AED is assigned on the 5th dose in which it has positive effect that reported the noticeable difference in the glucose level from the baseline data of those mice that had been induced by HCTZ, which established the hyperglycemic effect.

From the data gathered, the approximate effective dose is determined at the fifth dose specifically 5023.75 mg/kg. It corresponds to the study made by Dr. Jean Michel Cohen who declared the important property of the coconut oil which is a thermogenic causing energy expenditure to increase compared to other source of oils.

Determination of Bioassay

In this method, the researchers used the comparative bioassay technique wherein the blood glucose lowering activities of freshly prepared and marketed oil were compared to the positive control group which received glibenclamide as treatment and negative control group which receive the placebo drug. Each group was composed of four hyperglycemic induced rabbits. Overall results of the test showing the mean value and standard deviation of each group are presented in table 3.

Table 3. Bioassay of determination of the blood glucose lowering characteristics of freshly prepared and marketed coconut oil *(Cocos nucifera)* toward hyperglycemic rabbits

Types of Treatment	Baseline	Induced	Glucose level			
			Monitoring Post treatment			
			30mins	1h	4h	8h
Freshly Prepared	93±2.2174	138±2.3805	137±2.5820	135±2.0817	129±2.1602	133±2.2174
Prosource	92±2.2174	138±2.1602	137±1.4142	130±2.4495	135±1.9149	135±1.7321
Glibenclamide	92±1.4142	139±2.3805	134±2.9861	130±2.3805	122±1.7078	126±2.1602
Placebo	92±2.3629	138±2.5000	138±2.5000	138±2.8868	137±2.6458	134±2.7538

As depicted in the results, the test animals that received treatment freshly prepared and marketed coconut oil demonstrated a decrease in the blood glucose level at different monitoring time interval starting at 30 minutes monitoring (post treatment). Further, positive control group depicted a decrease in blood glucose level post treatment. On the other hand, group of test animals that received the placebo drug registered a decrease in the blood glucose level of 134 ± 2.7538 after 8-hour monitoring period, which apparently, cannot be attributed to the action of the placebo drug.

As shown by the data, the test drug is effective in lowering the blood glucose level of the test animals. On the other hand, glibenclamide is very effective based on the results of the bioassay. This is in accordance with the study done by Atang et al. which reported a very high efficacy of glibenclamide in reducing blood glucose3 level after a 12-day treatment (Ali, 2012).

Table 4. Two-way analysis of variance on the glucose level of the four groups of hyperglycemic-induced rabbits

Source	SS	Df	MS	F	P	Decision*
Treatment	344.19	3	114.73	20.7	0.0001	Significant
Time Monitoring	551.06	3	183.69	33.15	0.0001	Significant
Treatment x Time	394.19	9	43.8	7.9	0.0001	Significant
Error	266	48	5.54			
Total	1555.44	63				

*Calculation was performed at the 0.05 level of significance

Results of the statistical test proved that there is a significant difference ($p<0.05$) on the glucose level of test animals in terms of the types of four treatments and monitoring time. This clearly indicates that the four treatment administered have different effects on the blood glucose level of the hyperglycemic rabbits. Further, blood glucose level changes with monitoring time post treatment. To determine which of the four treatments and at what time the decrease in blood glucose level was significant, Tukey's multiple comparison test was performed and the results of the analysis are shown in tables 5A and 5B.

Table 5A. Tukey's multiple comparison test of mean difference of blood glucose level lowered by the types of test drugs

Mean Comparison		Mean Difference	Tukeys HSD critical value	Decision*
Freshly Prepared	Prosource	0.375	2.22	Not Significant
Freshly Prepared	Glibenclamide	3.625	2.22	Significant
Freshly Prepared	Negative control	2.875	2.22	Significant
Prosource	Glibenclamide	4.000	2.22	Significant
Prosource	Negative control	2.50	2.22	Significant
Glibenclamide	Negative Control	6.50	2.22	Significant

*Calculation was performed at the 0.05 level of significance

Results of the test clearly indicated that of the four types of treatment, test animals treated with glibenclamide showed the highest decrease in blood glucose level by 3.625 and 4.00 when compared to the freshly prepared and marketed coconut oil, respectively. This means that glibenclamide has been very effective in decreasing the blood glucose level of test animals compared with the other treatment. On the other hand, both test drugs (freshly prepared and marketed coconut oil) was found to have significantly decreased the blood glucose level of test animals by 2.875 and 2.50 when compared to the effect of placebo drug. Consequently, the experimental drug was effective in decreasing the blood glucose level of the test animals.

From the table above, compared to other variables, glibenclamide was found to be more effective which causes the significant effect on blood glucose lowering compare to test drug. It corresponds to the study of Langtry, H.D. and Balfour, J.A. which reports that glibenclamide appears to be very effective in reducing blood glucose level (Langtry, n.d.).

Table 5B. Tukey multiple comparison test of mean difference of blood glucose level lowered with monitoring times

Types of treatment	Mean Comparison		Mean Difference	Tukey's Critical value	Decision*
Freshly Prepared	30 mins	1 hour	2.50	2.22	Significant
	30 mins	4 hours	8.00	2.22	Significant
	30 mins	8 hours	4.00	2.22	Significant
	1 hour	4 hours	6.00	2.22	Significant
	1 hour	8 hours	1.00	2.22	Not Significant
	4 hours	8 hours	4.00	2.22	Significant
Prosource	30 mins	1 hour	7.00	2.22	Significant
	30 mins	4 hours	3.00	2.22	Significant
	30 mins	8 hours	3.00	2.22	Significant
	1 hour	4 hours	5.00	2.22	Significant
	1 hour	8 hours	5.00	2.22	Significant
	4 hours	8 hours	0	2.22	Not Significant
Glibenclamide	30 mins	1 hour	4.00	2.22	Significant
	30 mins	4 hours	12.00	2.22	Significant
	30 mins	8 hours	8.00	2.22	Significant
	1 hour	4 hours	8.00	2.22	Significant
	1 hour	8 hours	4.00	2.22	Significant
	4 hours	8 hours	4.00	2.22	Significant

*Calculation was performed at the 0.05 level of significance

Results of the test proved that a decrease in blood glucose level is dependent with time due to the significant difference ($p<0.05$) on blood glucose level with monitoring time. It further indicates that the optimum performance of the test drugs (freshly prepared coconut, marketed coconut oil and glibenclamide) was at 1 to 4 hours post treatment. The findings indicate that the study has established the capacity of the freshly prepared and marketed coconut oil as hypoglycemic agent, which indicates its potentiality to normalize high blood glucose level.

The test result confirmed that the decrease in blood glucose level is not only dependent on the concentration but also with time. Glibenclamide as a positive control among the four variables tested, exerts optimum effect on the test animals. According to the study, which explains the pharmacokinetics of glibenclamide, it approximately decreases blood glucose within 4 hours from the time of its absorption compared to the other drug. (Li, October 2011).

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Print ISSN 1656-0604
Online ISSN 2244-6532

Comparison of Micronutrient Content and Sensory Acceptability of Horseradish - Enriched Commercial Foodstuff and their Prepared Versions

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ABSTRACT

The nutritional value and sensory appeal of food are the main considerations for consumers' food choice. This study investigated the micronutrient (in terms potassium, phosphorus, calcium, iron, and sodium) content and sensory effects (in terms of aroma, taste, color, mouthfeel, and palatability) of horseradish-fortified commercial energy drink, bread bun, and instant noodles, and their plain versions added with fresh horseradish leaves. By experimental design, the plain versions were cooked with fresh horseradish leaves; then with the commercial foodstuffs as the control samples, subjected to atomic absorption spectrometric (AAS) elemental analysis and sensory evaluation. The results revealed that iron and calcium are higher in the prepared drink, commercial bread, and commercial noodles. Phosphorus is higher in the prepared bread and prepared noodles. The main issue is the very low potassium to sodium ratio of all tested foodstuff. In terms of sensory acceptability, the prepared drink gained a higher overall sensory acceptability, while the commercial bread and the commercial noodles got higher sensory acceptability than their prepared versions. T-Test analysis revealed a significant difference only between the commercial and the prepared noodles' overall acceptability, $t(24) = -3.011$, $p = .006$, implying non-comparable sensory acceptability of the two, in favor of the commercial noodles. Overall, the results prove that horseradish indeed renders the elemental nutrients calcium, phosphorus, iron, and potassium to any food added with its leaves, and that the amounts of fresh horseradish leaves added may be increased to improve the food's nutritional value. This could pave basis for initiating horseradish functional food development, production, and commercialization.

KEYWORDS: Nutrition, micronutrient, sensory acceptability, horseradish (Moringa olifeira), processed food, functional food, Davao City

INTRODUCTION

The food industry has long marketed processed foods, many of which can be considered junk foods being loaded with sodium and other flavorings and preservatives. Junk foods have become widely available in groceries, convenience stores, fast-food restaurants, and even through multi-media, usually looking very appealing. Fortunately, with more evidence linking junk food diet to cardiovascular diseases and other health conditions, people have begun to realize the effects of eating foods that are so far removed from their original state. Hence, manufacturers have insisted on referring to their products as snack foods, to detach from junk food reputation. Fortunately, regardless of the label, more consumers now consider nutritional content over sensory appeal in buying food.

The culprit in most processed foods is their high sodium content. Nutrition and medical experts worldwide warn that high sodium diet leads to fluid retention that can lead to higher blood pressure, which put people in higher risk of stroke, heart diseases, and kidney troubles. The Centers for Disease Control and Prevention advised that the body needs only 180 to 500mg of sodium per day to maintain its healthy function and has set an upper limit of 2,300mg per day as the highest daily amount of sodium that should pose no health risk to most healthy adults. However, due to extensive use of sodium in food stuffs, an average person easily exceeds this daily limit. An excessive sodium diet is a form of malnutrition (Harvard School of Public Health, 2016; Live Science, 2016; Mohan, 2013).

Yet worse about processed food diet is the possibility of acquiring deficiency malnutrition, including deficiencies in micronutrients calcium, phosphorus, iron, and potassium. Calcium deficiency can make the nervous system highly irritable, causing hands and feet spasms and muscle and abdominal cramps. Chronic calcium deficiency contributes to poor bone mineralization and result to osteomalacia and osteoporosis in adults, and rickets and impaired growth in children. The Food Nutrition Research Institute of the Department of Science and Technology (FNRIDOST) 8th National Nutrition Survey (NSS, 2014) conducted from June 2013 to April 2014 and covering all 17 regions and 45,047 households, revealed that 90 percent of Filipino households are not meeting the average calcium requirements. Like calcium, phosphorus help in healthy bone formation and prevents deficiency symptoms including weak bones and discomfort in various body joints. Phosphorus also promotes improved digestion, protein formation, hormonal balance, cellular metabolism and repair, and proper nutrient utilization, preventing phosphorus (Organic information Services Ltd, 2016).

Another malnutrition condition due to micronutrient deficiency is anemia which is caused by lack of dietary iron. Though the FNRI 8th NNS anthropometry on children and adults revealed declining prevalence of anemia in all population groups over the past 2-3 years, it still affects the population with infants six months to one year of age having the highest anemia rates (39.4%). Among the wealth quintiles, the middle quintile has the highest anemia levels (47.5%) for the six months to one year old, even higher than the poor (46.4 %) and poorest (43.1%) quintiles. The same age group for the richest quintile has higher anemia rates (30.8%) than the second richest quintile (26.6%).

Finally, potassium deficiency, characterized by an increase in blood pressure, (Rolfes et al., 2012) leads to cardiovascular diseases, and actually accounts for two-thirds of all strokes and half of heart disease. The 8th FNRI-DOST NNS revealed that about 22.3% of the adult population is considered hypertensive, and the prevalence of hypertension peaks in the 50-59 age group (31.1%). Potassium, a main blood electrolyte, is vital in cellular biochemical reactions, energy metabolism, protein synthesis (Haas, 2011), and most importantly, countering the bad effects of sodium by helping relax blood vessels, excreting the sodium and decreasing blood pressure (Harvard T.H. Chan School of Public Health, 2016).

The described malnutrition conditions may be alleviated by supplements of iron, calcium, phosphorus, and potassium. However, with current consumers' fast-paced lifestyle, regular taking of these supplements can easily get neglected. This could be addressed by integrating these micronutrients into some of the foodstuffs commonly popular with consumers.

Hence government health agencies worldwide are gearing towards research and development of food products that can render extra health benefits – the functional foods. A food product is considered a functional food when, apart from having the usual energy source like its carbohydrate and fat contents, it also contains extra nutrients known to address specific health issues. Functional foods are claimed to play a role in improving overall well-being and reducing or minimizing the risk of certain diseases and other health conditions. Examples of these foods include fruits and vegetables, whole grains, fortified foods and beverages and some dietary supplements (International Food Information Council Federation, 2011).

Foodstuffs that are plant- or herbal- fortified now abound in the market. For instance in the Philippines, many food products are labeled fortified with plants known to contain beneficial micronutrients, such as horseradish, which is locally known as malunggay. As the plant is proven to be easily cultivated and very nutritious, the Philippine Department of Health (DOH) has been campaigning for backyard-planting of horseradish and its utilization in household cooking.

Horseradish leaves have been reported to be a rich source of β-carotene, iron, calcium, phosphorus, and potassium and act as a good source of natural antioxidants; and thus enhance the shelf life of fat-containing foods due to the presence of various types of antioxidant compounds such as ascorbic acid, flavonoids, phenolics and carotenoids (Dillard & German, 2000; Siddhuraju & Becker, 2003; Anwar et al., 2005; Makkar & Becker, 1996). The flowers contain nine amino acids, sucrose, D-glucose, traces of alkaloids, wax, quercetin and kaempferat; the ash is rich in potassium and calcium (Ruckmani et al., 1998).

The high concentrations of iron, calcium, phosphorus, copper, vitamins A, B and C, α-tocopherol, riboflavin, nicotinic acid, folic acid, pyridoxine, β-carotene, protein, and in particular essential amino acids such as methionine, cystine, tryptophan and lysine present in Moringa leaves and pods make it a virtually ideal dietary supplement (Makkar & Becker, 1996; Anwar & Bhanger, 2003; Tsaknis et al., 1999). In fact, it has been used to combat malnutrition, especially among infants and nursing mothers. Remarkably, horseradish leaves contain more calcium than milk, more iron than spinach, and more potassium than bananas. (Fahey, 2005).

These nutritional properties of horseradish provide inspiration for the food industry to exploit the plant as a fortification for many foodstuffs. Examples of food products fortified with horseradish leaves which are currently available in groceries are energy drinks, instant noodles, and bread. Despite no official label confirmations from government health and consumer care agencies, these products have already gained popularity amongst many consumer groups like the teens and students for the energy drink and potato snack; the busy professionals for the horseradish noodles; and the bread-eater consumers for the horseradish bread. Nevertheless, there remain consumers who still prefer to use fresh horseradish as ingredient in their cooking.

Study Objectives. This study investigated the nutritional content and sensory effects of selected horseradish-fortified commercial food products (energy drink, bread bun, instant noodles), and compared them with the plain versions prepared with fresh horseradish leaves. Specifically, this study determined and compared the amount of calcium, phosphorus, iron, potassium, and sodium in the horseradish-fortified commercial foodstuff and their plain versions cooked with fresh horseradish; as well as the sensory acceptability of the food samples' aroma, flavor, color, mouthfeel and palatability. It likewise determined whether

or not the differences in the overall sensory acceptability of the commercial and prepared food samples are significant. This study is of relevance especially to consumers whose interest in the relationships between diet, health and food sensory attributes has somehow remained not fully addressed by research-based information, specifically about functional foods.

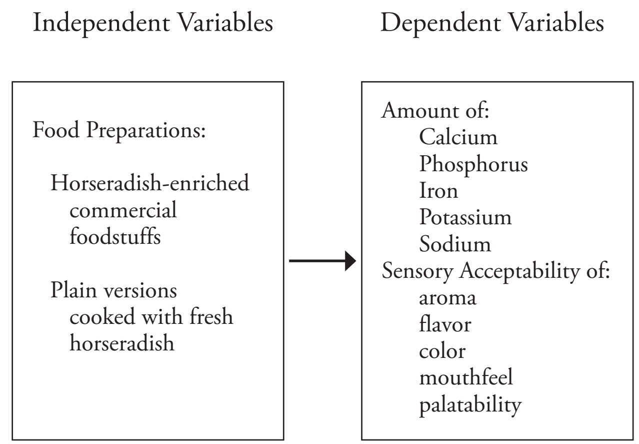

Figure1. The conceptual framework of the study

The preparations of horseradish-enriched commercial food products and their plain versions cooked or prepared with fresh horseradish served as the independent variables. The commercial products enriched with horseradish are the energy drink labeled to contain 25 leaflets of malunggay, bread bun labeled enriched with malunggay leaves, and instant mami noodles labeled containing a combination of corn and real malunggay leaves. The analyzed nutrients are phosphorus, potassium, calcium, iron, and sodium, which served as the dependent variables. Likewise, the taste-testers' sensory acceptability of the food samples' aroma, flavor, color, mouthfeel, and palatability served as dependent variables. These sensory effects are important aspects comprising the overall quality of food that make people either want to consume again the food or not.

Aroma and flavor both result from dissolved food chemicals as stimuli sensed by chemoreceptors and perceived by the brain. Aroma or food smell is sensed by olfactory nerves in the nasal cavity, while flavor or taste is sensed by taste buds in the oral cavity. Food smell usually serves as basis for flavor, as people usually judge good-smelling food as flavorful and therefore exciting to eat. Color means eye appeal which helps to merchandise the food. Color changes can considerably increase a food's acceptability that more colors going on in a plate makes the food more attractive (Choi, 2006; Palacio & Theis, 2010). Mouthfeel or oral tactility is an attribute of food texture relating to how the food feels to the tongue, teeth, and palate, or how the food is sensed inside the mouth; i.e. being viscous, granular, fibrous, floury, etc (Costell & Duran, 2000). Palatability describes the food's overall attractiveness or appeal to instigate appetite (Singh-Ackbarali & Maharaj, 2014).

METHOD

This study utilized experimental design to prepare horseradish-enriched energy drink, bread bun, and noodles. These prepared foodstuffs were then subjected to nutrient analysis and taste-testing to gauge their sensory acceptability amongst taste-testers. Their nutrient content (in terms of amounts of potassium, phosphorus, calcium, iron, and sodium) and sensory acceptability (in terms of aroma, taste, color, mouthfeel and palatability) were then compared with that of the equivalent commercial foodstuffs as the control samples.

For the sensory acceptability testing, a total of 25 participants composed of 10 UIC faculty members and 15 UIC Hotel and Restaurant Management (HRM) 4th year students were purposively chosen. Guided by the UIC – Research Ethics Committee (REC), all participants were 18 to 55 years old and excluded those with conditions that alter ones' sense of taste and smell like cold, allergy, cough, etc., and those with full stomach (satiety) at that time. Permission letters were secured from the ND/HRM/TM dean to recruit from amongst 4th year HRM students and from the college dean to recruit from amongst the college faculty to participate in the study.

The study was conducted at the University of the Immaculate Conception (UIC) Main campus, Fr. Selga St., Davao City. The nutrient analysis was conducted in UIC Science Resource Center (SRC). The different products enriched with horseradish were purchased from GMall and SM Lanang Premier groceries. The horseradish leaves were collected from Orchid St., Dona Caridad Village Sasa, Davao City. Samples of the plant materials were sent to the National Museum Botany Division for Authentication. The food tasting was held either at the Nutrition and Dietetics Laboratory 2 room or the Faculty room of UIC main campus. The whole study was conducted from May to December, 2015.

Figure 2 diagrams the overall study procedure. The foodstuff designated "commercial" are the packaged food products labeled to contain horseradish leaves. The plain versions were added with fresh horseradish leaves during cooking and designated as the "prepared" horseradish foodstuff. Horseradish leaves were standardized in terms of tree source, collection time, and weight. The first four horseradish stalks from the tip of each branch of the same tree were picked. The horseradish leaves were collected at 7am. They were washed with running water, de-stalked then placed in zip lock plastics, each plastic to have 40 grams horseradish leaves.

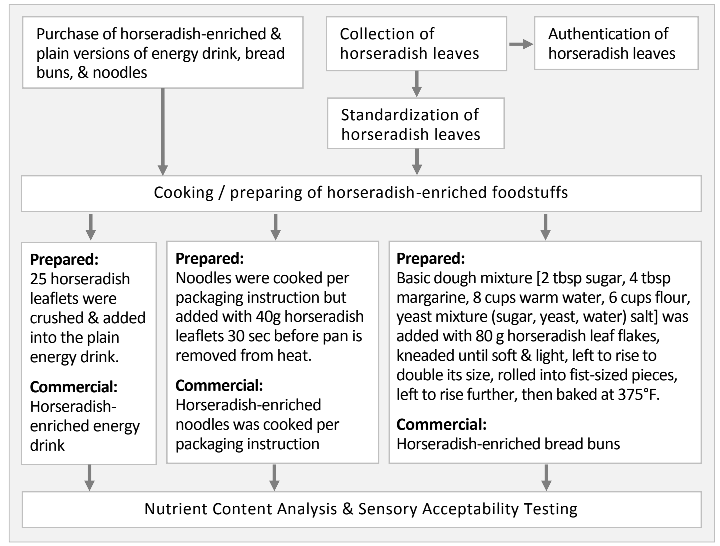

Figure 2. Flowchart of overall procedures

Nutrient content analysis

The UIC-SRC conducted the analysis of nutrient content using Atomic Absorption Spectroscopy (AAS) method. Atomic Absorption Spectroscopy is an analytical procedure for the quantitative determination of elements through the absorption of optical radiation by free atoms in the gas phase, wherein atomic line spectra are specific for the absorbing elements. Absorption is governed by the Beer-Lambert law (Bishop et al., 2013). Specified amounts of food samples per SRC requirement were sent to SRC for micronutrient content determination.

Sensory acceptability testing

The food samples' sensory effects in terms of aroma, flavor, color, mouthfeel, and palatability were scored by a consumer test panel (untrained taste-testers who represent the buying public) composed of UIC faculty and senior students, in the Home Economics room (for students) and the faculty room (for faculty) from 2:30-6 pm during the tester's vacant time. They were properly oriented and given specific instructions re the sensory effects and scoring the modified Hedonic Scale, avoidance of interaction with others, and sipping of water during intervals in between sample tasting to prevent lingering flavors. Each was served 15-20 mL each of the plain horseradish-fortified drink and plain version prepared with fresh horseradish; 10-12 g each of the horseradish-fortified bread bun and the plain version baked with fresh horseradish; and 30-35 g each of the horseradish-fortified noodles and the plain version cooked with fresh horseradish. The food samples were served at uniform temperatures (still warm for noodles, room temperature for drinks and bread) and in uniform disposable white containers. The food tasting area was well-lit and in a comfortable temperature.

Data analysis

The gathered data were analyzed using descriptive mean and paired 2-tailed test to determine significant differences between the respondents' sensory acceptability of the commercial and prepared horseradish enriched food samples.

RESULTS

Micronutrient analysis by Atomic Absorption Spectroscopy (AAS)

Tables 1A, 1B, and 1C compare the amounts of elemental micronutrients in horseradish-fortified commercial energy drink, bread, and noodles, respectively, with that of their prepared versions with fresh horseradish.

Table 1A. Micronutrient amounts in commercial and prepared horseradish energy drinks

Micronutrient	Amount (µg/g) in	
	Prepared Energy Drink with Horseradish	Commercial Energy Drink Fortified with Horseradish
Calcium	↑ 22.88	17.20
Phosphorus	67.67	↑ 80.83
Iron	↑0.11	0.06
Potassium	68.54	↑ 71.59
Sodium	↓ 366.00	432.00

The elemental micronutrients iron and calcium were tested much higher in the prepared energy drink, respectively 83% and 33% higher than the iron and calcium contents of the commercial drink. The prepared drink also has 18% lower sodium content. On the other hand, phosphorus and potassium are 19% and 4% respectively higher in the commercial drink than in the prepared drink.

Table 1B. Micronutrient amounts in commercial and prepared horseradish bread

Micronutrient	Amount (µg/g) in	
	Bread Bun Baked with Horseradish	Commercial Bread Bun Fortified with Horseradish
Calcium	497.00	↑ 1,269.00
Phosphorus	↑ 963.00	797.00
Iron	13.73	↑ 15.71
Potassium	↑ 1,039.00	983.00
Sodium	↓ 4,512.00	4,709.00

The calcium content of the commercial horseradish bread bun is interestingly 155% higher than that of the prepared bread baked with horseradish leaves. The commercial bread also has 14% higher iron content than prepared bread. On the other hand, phosphorus and potassium are respectively 21% and 6% higher in the prepared bread, which also has 4% lower sodium content.

Table 1C. Micronutrient amounts in commercial and prepared horseradish noodles

Micronutrient	Amount (μg/g) in	
	Plain Instant Noodles Cooked with Horseradish	Horseradish-fortified Instant Noodles
Calcium	88.13	↑ 110.00
Phosphorus	↑ 236.00	186.00
Iron	3.27	↑ 3.36.00
Potassium	463.00	↑ 473.00
Sodium	5,837.00	↓ 4,836.00

The potassium and iron contents of the commercial horseradish-fortified noodles are just slightly higher (less than 3% higher) than those of the plain version cooked with fresh horseradish leaves. Calcium is 25% higher and sodium is 21% lower in the commercial horseradish noodles, whereas phosphorus is 27% higher in the plain noodles cooked with fresh horseradish.

Sensory acceptability testing

Tables 2A to 2C comparatively present the taste-testing participants' sensory acceptability of the selected horseradish-fortified energy drink, bread bun, and instant noodles, and of their plain versions prepared with fresh horseradish. The participants rated the food's aroma, taste, color, mouthfeel and palatability based on a modified 1 to 5 hedonic scale with corresponding description of extremely disliked, moderately disliked, acceptable, moderately liked, and extremely liked, respectively.

Table 2A. Tasters' acceptability of prepared vs. commercial horseradish energy drink

Sensory Effect	Mean Rating			
	Prepared Drink		Commercial Drink	
Aroma	3.88		3.48	
Flavor	3.92		3.44	
Color	4.12		3.76	
Mouthfeel	3.92		3.48	
Palatability	3.64		3.68	
Overall Acceptability	3.90		3.57	
T-Test	N	t	df	p
	25	1.341	24	.193

95 % Confidence level (p = .05)

The prepared energy drink gained a higher sensory acceptability mean rating (3.90) than the commercial energy drink (3.57). Except for palatability, all other sensory effects are liked better by the tasters in the prepared drink than in the commercial one. Nevertheless, T-Test analysis revealed no significant difference between the overall acceptability of the prepared and the commercial drink, $t(24) = 1.34$, $p = .193$, implying that the two drinks' sensory acceptability are comparable.

Table 2B. Tasters' acceptability of prepared vs. commercial horseradish bread bun

Sensory Effect	Mean Rating			
	Prepared Bread		Commercial Bread	
Aroma	3.52		3.80	
Flavor	3.92		4.00	
Color	4.24		4.04	
Mouthfeel	3.88		4.08	
Palatability	3.88		4.20	
Overall Acceptability	3.89		4.02	
T-Test	N	t	df	p
	25	-.786	24	.440

95 % Confidence level (p = .05)

The commercial bread bun gained a slightly higher sensory acceptability mean rating (4.02) than the prepared bread bun (3.89). Except for color, all other sensory effects such as aroma, flavor, palatability, and mouthfeel are liked better by the tasters in the commercial bread bun than in the prepared one. Nevertheless, T-Test analysis revealed no significant difference between the overall acceptability of the prepared and the commercial bread, t(24) = -.786, p = .440, implying that the two bread's sensory acceptability are comparable.

Table 2C. Tasters' acceptability of prepared vs. commercial horseradish noodles

Sensory Effect	Mean Rating			
	Prepared Noodles		Commercial Noodles	
Aroma	3.68		3.96	
Flavor	3.40		4.28	
Color	3.72		4.20	
Mouthfeel	3.64		4.24	
Palatability	3.84		4.12	
Overall Acceptability	3.66		4.16	
T-Test	N	t	df	p
	25	-3.011	24	.006

95 % Confidence level (p = .05)

The commercial instant horseradish noodles gained a higher overall sensory acceptability mean rating (4.16) than the prepared plain version added with horseradish (3.66), as also exhibited by the higher mean ratings of the commercial noodles' aroma, flavor, color, palatability, and mouthfeel. As such, T-Test analysis revealed a significant difference between the overall acceptability of the prepared version and the commercial noodles, t(24) = -3.011, p = .006, implying that for the taste-testers, the two noodles' sensory acceptability are not comparable, with the commercial one being significantly better.

DISCUSSION

Micronutrient content of the commercial and prepared foodstuff

Though at different levels, all food samples were tested to contain elemental micronutrients phosphorus, potassium, calcium, iron, and sodium. For point of comparison, the foodstuff with higher contents of phosphorus, potassium, calcium, and iron, while lower content of sodium, is considered better due to the bad effects of excessive sodium which is ubiquitous in food preparation.

Commercial vs. Prepared Horseradish Energy Drink. The drink prepared with fresh horseradish leaves turned out better than the commercial horseradish drink in terms of their calcium, iron, and sodium contents. On the other hand, the commercial horseradish-fortified energy drink tested better than the prepared drink in terms of the phosphorus and potassium content. Bottled energy drinks have become widely popular among students and young workers mainly because of its having B complex energy booster vitamins and elemental electrolytes.

In this study, the elemental micronutrients that can be considered important in energy boosting are iron, potassium, and phosphorus. Iron serves as the red blood cells' oxygen-binding component and lack of iron can result to weakness and fatigue due to insufficient oxygen supply to cells. On the other hand, potassium, as a main blood electrolyte is important in energy metabolism, cellular biochemical reactions and electrical functions by regulating the water and the acid balance in the blood and tissues (Haas, 2011); whereas phosphorus participates in cellular metabolism and repair, and proper nutrient utilization (Organic information Services Ltd, 2016). Hence, taking either of the two drinks can be expected to help boost energy.

Commercial vs. Prepared Horseradish Bread Bun. The bread baked with fresh horseradish leaves turned out better than the commercial horseradish-fortified bread in terms of their phosphorus, potassium, and sodium contents. Interestingly, the commercial horseradish-fortified bread has more than double calcium content than the prepared bread. This may be due to the possibility of the commercial bread containing other ingredients like milk or egg that were not included as basic ingredients in the prepared bread. The phosphorus and iron contents of both commercial and prepared bread, and the calcium content of the commercial bread can be considered high relative to the body's daily need for the said elements, as presented in table 3.

Noticeably, both bread preparations were found to have very high sodium content that a small loaf (300-350 g) of either bread will already supply the required daily intake (table 3). This high sodium content result for both breads is consistent with published literature (Live Science, 2016) that just a slice of bread alone can have 250 mg of sodium, unless it is specially baked without salt or using herbal replacements. Unfortunately, because of its use to make food tasty and/or last, it's simply being added to food during cooking and/or processing, so that an average person easily consumes more sodium than what is considered harmless. Alarmingly, apart from the proven effects of too much sodium such as stroke, heart failure, kidney disease, and osteoporosis, the World Cancer Research

Fund and American Institute for Cancer Research (Harvard T.H. Chan School of Public Health, 2016) concluded that salt and salty foods are a "probable cause of stomach cancer."

Commercial vs. Prepared Noodles with Horseradish. Except for phosphorus, the amounts of the other analyzed elemental micronutrients turned out better in the horseradish-fortified instant noodles, though only in little degrees, than in the plain version cooked with fresh horseradish. Nonetheless, both have high contents of the elemental micronutrients to help meet an individual's daily DRI (table 3). Again not surprisingly, the sodium contents in both noodle preparations are noticeably the highest amongst analyzed elements. Apart from the sachet of seasoning that goes with the pack of noodles, salt was added in cooking the plain version with fresh horseradish to improve the taste, hence the higher sodium content. This illustrates the habitual choice of many Filipino consumers for taste over health. Again, there is a need for education campaign regarding healthy food preparation and consumption. The American Diabetes Association Nutrition and Medical Affairs released a statement (Live Science, 2016) that if everybody reduced sodium in their diet, the rates of heart disease in the United States would go way down.

Table 3. Dietary Reference Intake (DRI): Recommended Dietary Allowances (RDA) and Adequate Intakes (AI) for phosphorus P, potassium K, calcium Ca, iron Fe, and sodium Na

Age (yr)	Fe (mg)	Ca (mg)	Fe (mg)	K (mg)	Na (mg)
9-13	1250	1300	8	4500	1500
14-18	1250	1300	11	4700	1500
19-50	700	1000	Male 8 Female 18	4700	1500
51-70	700	Male 1000 Female 1200	8	4700	1300
> 70	700	1200	8	4700	1200

RDA, in bold, is the average daily intake sufficient to meet the required nutrient of nearly all healthy individuals in a group. If no RDA is scientifically established, AI, in italics, is used, which is believed to cover the needs of all healthy individuals in a group (Food & Nutrition Board, US Nat'l Academy of Sciences, 2011).

Because potassium counters the bad effects of excessive sodium, any individual from any age group needs more than three times more potassium than sodium (table 3) but with the popularity of processed foods, most meals just have the opposite. This is true with all the tested food products: the prepared energy drink has more than five times sodium content than its potassium content, while the commercial energy drink has six times more sodium than potassium. Both the prepared and commercial bread buns contain four times more sodium than potassium; and worst of all, both noodle preparations have more than ten times more sodium than potassium content. Health-wise, these results strongly indicate a need to consciously decrease the amount of salt during food processing for the food industry, as well as during food preparation for consumers.

Sensory acceptability of the foodstuff

Of the tested sensory effects (aroma, flavor, color, mouthfeel, and palatability), none got a mean score lower than 3 for both the prepared and commercial foodstuff, indicating testers' general acceptance of the food samples. This is expected as the food samples are not new products but have been around long in the market and in fact are popular amongst consumers. On average, the taste-testers moderately liked the overall sensory effects of both the commercial and prepared food products.

Commercial vs. Prepared horseradish energy drink. The prepared energy drink gained a higher sensory acceptability mean rating (3.90) than the commercial energy drink (3.57), though the difference is not significant (p=.193), implying that the two drinks have comparable sensory acceptability. Interestingly for the prepared drink, color and palatability got the highest and the lowest mean ratings, respectively. Color is commonly used to evaluate a food's desirability (Choi, 2006), hence palatability. In the case of the prepared energy drink, the darker color imparted by the fresh horseradish leaves may be attractive to the testers but could not be enough to establish the drink as equally appetizing.

On the other hand, color and palatability scored first and second, respectively in the commercial drink, while flavor scored the lowest. In this case, the drink's attractive color could have increased its appeal but not the flavor. This shows that color, as a visual attribute, may be exploited in food packaging or plating to make food attractive but cannot improve food flavor. This observation is consistent with published data (Choi, 2006) that color can be deceiving and mask real food

quality. This is also consistent with a specific study in Africa (Adinsi et al., 2014) on consumer acceptability of developed malted and fermented cereal beverages, which found that test panel's acceptability was negatively correlated with the beverages' white color, but was positively and highly correlated with the drinks' fermented odor and acidic taste.

A market research (Morata, 2013) revealed that in the Philippines, energy drinks are most popular among 13 to 35 year olds, consuming approximately 65% of the energy drink market, which in 2011 totaled Php7.9 billion for Asia Brewery Inc alone. The Philippine Food and Drug Administration (FDA) so far has 67 energy drinks registered, which, based on label statement, may contain overdose of sugar as energy source, lots of caffeine, and other energy-boosting substances like taurine, B vitamins, Ginseng, L-carnitine, an even malunggay.

Commercial vs. Prepared horseradish bread bun. The commercial bread bun gained a slightly higher (4.02) sensory acceptability mean rating than the prepared bread bun (3.89) but the difference was not significant (p=.440), implying that the two breads' sensory acceptability are comparable. Again, color scored highest for the prepared bread, indicating that the natural color imparted by the horseradish to the bread is visually pleasing, but in terms of palatability, it still scored lower (3.88) than the commercial bread (4.22). Aroma scored the lowest for both breads, which is expected as bread does not necessarily contain volatile substances to serve as stimulant for the olfactory nerves. While the characteristic bread aroma is strongly evident in freshly baked bread or at the end of the baking process due to the volatile organic substances produced during baking, these don't last in the bread.

Like noodles, bread is becoming a strong rice contender in terms of carbohydrate source of Filipino diets, Because of being 'ready-to-eat' without further preparation, bread is a preferred relief goods. The Department of Trade and Industry (Philippines Relief Web, 2014) in fact collaborated with the Philippine Baking Industry Group (PBIG), Filipino-Chinese Bakery Association Inc (FCBAI), and Philippine Federation of Bakeries Association Inc. (PFBAI) to help stabilize bread supply in calamity-stricken areas at the time most of the supermarkets and retail stores become non-operational due to the disasters.

Commercial vs. Prepared horseradish noodles. The commercial instant horseradish noodles gained a higher (4.16) overall sensory acceptability mean rating than the prepared plain version added with horseradish (3.66), exhibiting a significant difference (p = .006) between their overall acceptability in favor of the commercial noodles. Intriguingly, flavor scored the highest in the commercial noodles but the lowest in the prepared version. This indicates Filipino consumers' preference for instant noodles as part of staple food, and may further imply their preference for the commercial noodles' pure or "unadulterated" taste without vegetable additions. This is consistent with the WHO-South East Asian Region (SEAR) report (Mohan, 2013) that changes in lifestyles and dietary patterns across SEAR have led to consumption of unhealthy diets that are high in salts, fats and sugars, and low in fruits and vegetables. Estimates indicate that almost 80% of people do not consume adequate quantities of fruits and vegetables, which are good sources of potassium and can blunt the impact of sodium on blood pressure.

The result further underscores the strong market of instant noodles in the Philippines, which ranked 9th in terms of quantity of Nissin packets alone sold in 2014, with a world's share of 2.7%. The same brand reported a whopping $431.6 billion of net sales in fiscal year 2015 (Nissin Foods Holdings, 2016). Further, a market report titled Instant Noodles Industry in the Philippines: Analysis of Growth, Trends and Forecast emphasized that the Philippines is one of the most favorable Instant Noodles market in the world driven by factors like growing youth segment and increasing working population, growing urbanization and Increase in number of middle class population, and fast paced life and lack of time (Mordor Intelligence, 2016).

Recommendations and Translational Implications

This study's sensory evaluation was carefully conducted but could be more improved by employing a single-blind system to avoid biases during taste-testing. Also, having three trials in the AAS determination of micronutrient content would have revealed whether the prepared and commercial food micronutrient contents are significantly different. Nevertheless, the findings prove that horseradish indeed renders the elemental nutrients calcium, phosphorus, iron, and potassium to any food added with its leaves. However, it reveals that simply adding it in the food does not make the food's nutrients optimized. For the prepared foodstuff, the amounts of fresh horseradish leaves added may be increased to improve micronutrient contents. The main issue is with the ratio of potassium to sodium content of the food products. In general, there is a need for consumers to cut down on processed foods, to read product labels and choose low sodium and high potassium food products, and to consciously use lesser sodium in cooking

or preparing meals.

Importantly, the study findings strongly provide basis for the following suggestions for relevant authorities: 1) Establish a Functional Food Research and Development Program to come up with functional food products that are not only physiologically beneficial but also appealing, for commercialization and mainstream public consumption; 2) Implement a Food Labeling System that inform consumers and enable them to choose healthier foods; 3) Collaborate with the Food Industry in salt reduction particularly as regards processed foods; and 4) Create Nutrition Education Campaigns to increase public understanding of nutritional information and promote home-cooked foods using minimal salt. Finally, it is hoped that consumers become more health-conscious and take nutrition over sensory appeal as primary consideration for choosing food.

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Extent of Challenges Encountered by Community Pharmacists in Correlation to Patient Medication Counseling Capabilities

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ABSTRACT

Medication error is an inappropriate medication use that may lead to patient harm if not prevented. Thus, providing patient medication counseling by the community pharmacists can reduce this problem. This study used correlational survey design aimed to determine the influence of the extent of challenges such as system, pharmacy environment, patient and pharmacist encountered by community pharmacists on patient medication counseling. Purposive sampling method was used with 35 respondents working in drugstores within downtown area in Davao City. Results were statistically treated with frequency and percentage for the demographic profile, one-way anova and t-test and pearson r product-moment correlation for the level of capability on counseling and the extent of challenges encountered by the respondents. Based on the treatment, it showed that majority of the respondents were female 21-30 years old, female, single and served between 1-5 years in chain pharmacy. Generally, they are moderately affected by the system, patient and pharmacist challenges but highly challenged in the aspect of pharmacy environment. The level of capability in terms of knowledge and attitude revealed moderate result but demonstrated high in the practices. Also, there was no significant difference in the capability of the respondents on counseling when analyzed according to demographic profile and no significant difference between the extent of challenges encountered and their level of capability.

KEYWORDS: Medication error, patient medication counseling, community pharmacists

INTRODUCTION

Arising number of medication errors, dispensing errors and antibiotic resistance are just few of the cases that cause harm to the patients despite therapeutic advancements and efforts of healthcare members.

The Institute for Safe Medication Practices (ISMP) stated that, community pharmacy settings find estimates of medication errors ranging from 1.5 to 4 percent of prescriptions filled for ambulatory patients. The causes for these medication errors include failed communication, lack of patient education, incorrect drug administration, dispensing process and drug distribution, knowledge level of pharmacist, and patient and prescriber. Aitken (2012) also added that there was an estimated loss of USD 500 billion annually due to lack of responsible use of medicines as discussed during the 2012 Centennial Celebration of International Pharmaceutical Federation (FIP).

Moreover, outpatients in the United States faced a costly threat of adverse drug events (ADEs) and medication errors (MEs) plus added drug-related problems amounting to USD 77 to 177 billion annually. Although 20% to 28% of these adverse drug events are preventable because these are results of errors, it occurs that 2% to 21% are outpatient prescriptions. These preventable ADEs in medicare recipients cost the US an estimated USD 887 million (Murray et al., 2009).

Another medication error review conducted in the Southeast Asian countries revealed that from the Philippines, missed dose range is up to 41.94%, wrong time dosing covers 40.32% and 18.8% for erroneous administration which needs to be reduced (Salmasi et al., 2015).

Hence, to prevent the widespread of these alarming cases of medication and dispensing errors, community pharmacists as health care members are in good position to guide the patients by giving correct medication instructions. Among the health professionals, community pharmacists are the most accessible to the general public in which they supply medicines in accordance with prescriptions and give non-prescription drugs legally. They are approached by both healthy and sick individuals, which cover a large proportion of the population (Hassali et al., 2009).

Their most important role is to do patient counseling which is to elevate the quality of life and give quality care for patients. However, opposing to this goal is the existence of "drug misadventures" which refers to adverse effects, drug interactions, and errors in the use of medication, including non-adherence to treatment programs (Rantucci, 2007). Kris Weerasuriya (2012) of WHO Switzerland also mentioned during the 2012 Centennial celebration of International Pharmaceutical Federation (FIP), that in the health care system, pharmacists are not merely dispensers but

guidance counselors on aspects related to medicines.

In addition, approximately 83% of errors are detected during counseling and corrected before the patient leaves the pharmacy. Patient counseling is the most important strategy because this is the last venue of contact between the patient and pharmacist (Nair et al., 2010).

Furthermore, the community pharmacy practice in our country focuses largely in dispensing with minimal patient medication counseling and has become transactional in nature. This large practice is strengthened by the fact that community pharmacy services are dominated by chain pharmacy operations where 58% is contributed by just one single chain with more than 900 outlets and 70% of the 42% is from the other top five chain pharmacy operations (Ocampo, 2014). Also, in the study conducted by Solidum in 2013, she identified the roles of the pharmacists in health promotion against dengue which showed that counseling had obtained the least percentage among the roles as only 4% was consumed in giving information while 45% on drug dispensing.

Based on the information above, it is deemed imperative that this study was conducted to determine the extent of challenges encountered by community pharmacists as it correlates on their patient medication counseling capabilities in the many independent and chain drug stores in Davao City which can lessen the medication errors and enhance adherence to maximize the benefit of the medications.

Study Objectives. This study aimed to determine the extent of challenges encountered by community pharmacists as correlates on their patient medication counseling capabilities. Specifically, it determined a) the demographic profile of the community pharmacists; b) the extent of the challenges they encountered in terms of the system, pharmacy environment, and patient and pharmacist challenges; c) their level of capability on patient medication counseling in terms of knowledge, attitudes and practices, and whether they significantly differ according to their profile; and d) the existence of significant relationship between extent of challenges encountered and the level of capability of community pharmacists.

Theoretical Framework

It is beneficial to recognize pedigrees of counseling theories in psychological perspective as it is also a major component of patient medication counseling. One of these is the Humanistic Theory developed by Carl Rogers (1959) known as person-centered approach. The focus of his theory is "on the person's subjective view of the world"; to be able to connect with his/her self-worth and ideal self-leading to a person fully effective and functional. Moreover, the humanist considers people's thoughts and feelings and not just behavior. This means that when pharmacists counsel patients they are aware that patients are not only acting on the basis of external factors by stimulus and reward but is also recognizing their thoughts and feelings. As an example, when the patient is nonadherent, he/she shows refusal of taking medications but is still affected by thoughts and feelings towards his/her illness and medication use. Thus, pharmacists' counseling should acknowledge the patient's feelings and thinking. In addition, person-centered approach to counseling anchors on the idea that people tends to grow and enhance their capacities on genuine decision-making. A person is able to solve his problems with the intervention of a helping person who is nonjudgmental and accepting. From this line, the pharmacist is the helper guiding the patient's ability in solving their medication predicament to get the maximum benefit of their therapy (Rantucci, 2007).

The study of Laaksonen et al. (2014) which involved 37 community pharmacists in the south of England, completed clinical pharmacy training to provide medication reviews for elderly patients with take home medicines of four or more. Then, a performance assessment was made based on a sample of 244 referrals written by 20 community pharmacists. As a result, the clinical pharmacists identified 908 drug-related problems (DRPs) and suggested 1,489 solutions; the community pharmacists determined 75% of these DRPs (1% incorrectly suggested and 24% were missed) and recommended 58% of the solutions (6% were incorrectly suggested and 36% were missed). Although the pharmacists were self-selected, the study presented useful judgment to train clinical pharmacists in performing clinical medication review as part of counseling tasks.

Another study was conducted by Schnipper et al. (2006) emphasizing the role of pharmacist counseling in preventing adverse drug events (ADEs) after hospitalization. The study enrolled 178 patients; 92 received pharmacist interventions and 84, usual care. The results revealed that during the interventions, the pharmacists identified many types of Drug-Related Problems (DRPs). These included 34 missing medications, a different dose or frequency of medication in 12 cases and 11 cases for different medication in the same class. Forty-five patients (49%) had 1 or more unexplained discrepancies in their discharge medication orders. Pharmacists also discovered that 15 patients (16%) admitted to having had problems with their medication regimens before admission, including possible side effects and difficulties with adherence. The pharmacists suggested 23 changes to discharge medications on other clinical grounds (eg. to simplify a medical regimen or avoid a drug interaction). Overall, pharmacists recommended 80 changes in 55 patients (60%). In 33 patients (42%), discrepancies

were accounted for by reported changes by the patients' physicians or were changes in "as-needed" or over-the-counter medications only. The 28 remaining discrepancies in 23 patients (29%) remained unexplained. Most discrepancies involved changes in dose or frequency or complete omission of a prescribed medication.

Conceptual Framework

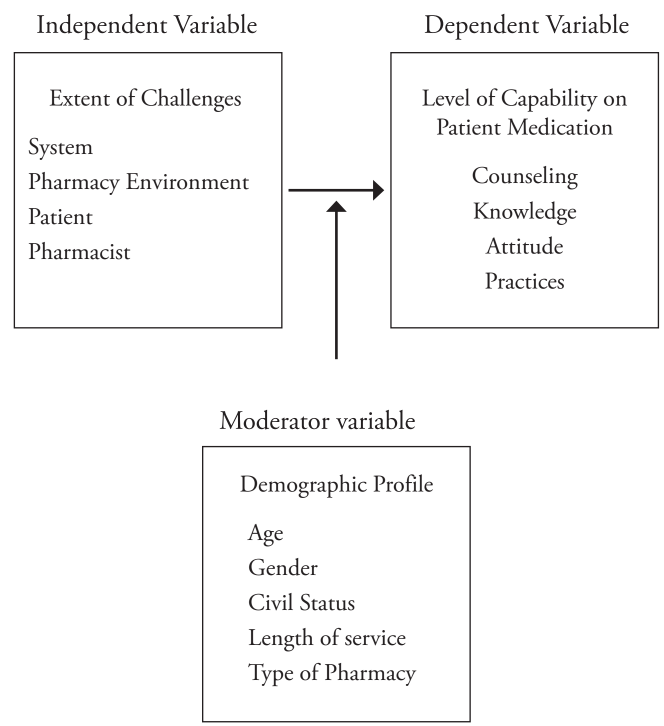

Figure 1. Conceptual framework showing the relationship of the variables of the study

Figure 1 reflects the conceptual framework of this study. It shows the relationship of independent variables and dependent variables. The independent variables are the extent of challenges categorized as a.) system challenges, which refers to the type of activities that pharmacists engage in and the human resource issue on incentives and policy change; b.) pharmacy environment challenges, which denotes the physical structure and working atmosphere of the pharmacy conducive for therapeutic interaction; c.) patient challenges, which are about patient awareness for counseling and their comprehension skills; and, d.) pharmacist challenges, which refers to the pharmacist's confidence level in giving medication counseling accuracy.

Moreover, the dependent variable is the level of capability on patient medication counseling of the community pharmacists which is subdivided into knowledge, attitudes and practices. Knowledge is the capacity of the community pharmacists in providing information to the clients or patients regarding medication therapy. Attitudes are the capacity of the community pharmacist to provide additional services to their patients or clients. Practices are the capacity of the community pharmacists to perform their expected routine tasks.

A moderator variable was also included. The demographic profile of the respondents which covers the age, gender, civil status, length of service and type of pharmacy serves as a special type of independent variable in order to determine if it may affect capabilities. As we age, the hearing, vision, physical strength and energy, handling pressure and memory are factors that might affect the respondent's performance. Gender is also considered since pharmacy workforce is dominated by females which are more inclined to patient-facing roles than males. Civil status, whether single or married pharmacists, do their counseling tasks effectively despite the challenges of their personal lives. The length of service is also a factor to consider since longevity affects the constancy of giving advices to patients. Lastly, the type of pharmacy as another factor looks into the variations of the demands of patient counseling in many independent and pharmacy chains.

METHOD

Research Design

A descriptive correlational approach was used in this study. According to Calmorin (2007), correlational approach is designed to determine the relationship of two variables (X and Y) whether the relationship is perfect, very high, high, marked or moderate, slight or negligible. Correlational approach design is most suitable in this study because it determines the relationship between two variables, namely, the extent of challenges that influence community pharmacists in performing patient medication counseling and their level of capabilities.

Research Locale

The researcher chose Davao City, specifically the downtown area as its research location. Since Davao City is among the most populous metropolitan areas in the country, many pharmaceutical businesses have been arising particularly drugstores or community pharmacies. It can be found mainly near big hospitals, malls and markets where people are accumulated. Independent pharmacy is mostly situated at the corner blocks or streets while chain pharmacies are easily noticed in nearby locations within first class villages.

Sampling Technique

The respondents of the study were the community pharmacists who are actively connected to either independent or chain community pharmacies for more than six months. There were 50 prospect respondents for this survey, however, only 35 responded. The researcher employed the purposive sampling method by selecting respondents which would best represent the study. A self-constructed questionnaire was validated and used for gathering data. Since there was no available standard questionnaire for this study, hence reliability test was done. It consisted of 15 items for the level of capability in terms of knowledge, attitude and practices. Also, there were 29 item questions for the extent of challenges experienced by the community pharmacists.

The questionnaire contained a checklist which is designed for the respondents to determine the level of frequency they experienced on the mentioned challenges. Furthermore, the study used the Likert Type Scaling Method for the extent of challenges in which each item may be rated according to five levels to be chosen by the respondent where it denoted that 1 = never, 2 = rarely, 3 = sometimes, 4 = often, 5 = always. While for every item of the level of capability was rated 5 = very high, 4 = high, 3 = moderate, 2 = low, 1= very low. The overall mean scaling indicated 4.50-5.00 = very high, 3.50- 4.49 = high, 2.50-3.49 = moderate, 1.50-2.49 = low and 1.00-1.49 = very low.

Data Gathering Procedure

This research observed the following steps in order to determine the correlation of the extent of challenges and the level of capabilities of community pharmacists on performing patient medication counseling. The first step was the validation of questionnaires wherein three validators came from chain and independent pharmacies with more than five years of employment while two from the academe. A letter of consent was submitted and questionnaires were given to drugstores by the researcher in order to personally approach the pharmacists and explain to them the survey.

After a week, the researcher gathered the questionnaires from the respective community pharmacists to where it was given. The final step was the analysis based from the encoded data.

Statistical Tools

The statistical techniques used in the study were the following:

Frequency and Percentage was used in the study to present the demographic profile of the respondents. Also, One-Way Anova and t test were used to determine if there is a significant difference on the level of capability among community pharmacists on patient medication counseling when segmented according to demographic profile. Pearson r Product-moment Correlation was for the inferential statistical tool to measure the degree of extent of challenges encountered by the community pharmacists in correlation to their level of capability on patient medication counseling.

RESULTS AND DISCUSSION

To determine the extent of challenges that may influence community pharmacists to perform patient counseling, the demographic profiling of 35 respondents was done. The overall data are shown in table 1.

Table 1. Demographic profile of the community pharmacists

Profile of the Respondents	Categories	Frequency	Percent (%)
Age (years)	21-30	21	60.00
	31-40	5	14.30
	41-50	6	17.10
	51 and Above	3	08.60
	Total	35	100.00%
Gender	Male	6	17.10
	Female	29	82.90
	Total	35	100.00
Civil status	Single	21	60.00
	Married	14	40.00
	Total	35	100.00
Length of Service (year)	Below 1 year	8	22.90
	1-5 years	20	57.10
	6-10 years	2	05.70
	11 years & above	5	14.30
	Total	35	100.00
Type of pharmacy	Independent	15	42.90
	Chain	20	57.10
	Total	35	100

Demographic analyses of the data have revealed that most of the respondents are female (82.9%) at age bracket of 21-30 years old, single (60.0%), with 1-5 years of experience (57.1%) and working in a chain pharmacy (57.1%). This means that most of the female respondents are in their early career as community pharmacists. According to FIP Global Pharmacy Workforce report in 2012, there is an increased ratio of female pharmacists with an average of 54.9% (range 4.8% to 92.4%). This change conveys that pharmacy as a professional medical career remains attractive for women. One possible factor could be evolving roles towards more patient-facing roles and greater flexibility of career structures and breaks.

Moreover, as to the length of service as to why community pharmacists stayed only between 1-5 years, the possible reason is to work abroad. There is an increasing migration from less-developed countries particularly from Africa and Asia to more-developed countries (FIP Global Pharmacy Workforce, 2012). Reasons for migration include better ways, supporting family needs, political and social instability, poor living conditions, poor working conditions and management, unsafe environment, further training and qualifications, and job opportunities and satisfaction. Likewise, the Philippine Overseas Employment Administration (POEA) has recorded a total of 1,821 who left to work overseas either as pharmacist or pharmacy assistants during the 10-year period from 1997-2007. The preferred destination is Saudi Arabia with 86% working as pharmacy assistants and 51% as pharmacists. Also, the Philippines is one of the sources of international pharmacy graduates (IPGs) in countries like Canada, US, Australia and the Middle East countries among others (Loquias & Robles, 2012).

Furthermore, for the type of pharmacy, 77% of the pharmacy workforce in the country was from community setting. Also, a detailed perusal was made from Food and Drug Administration (FDA) during 2002 to 2008 in which 1000 drugstores are added yearly, this entails the presence of at least 1 pharmacist during operation hours (Lorenzo & Cruz, 2001; Loquias & Robles, 2012;). This only means that many businessmen venture more in the pharmaceutical industry particularly putting up drugstores.

Knowing the importance of pharmacists' counseling on patient medication, the researcher further determines the extent of challenges among community pharmacists on medication counseling. The overall data are shown in Table 2.

Table 2. Extent of challenges among community pharmacists in medication counseling in terms of system challenges

Item #	Statements	Mean	Descriptive Equivalent
1	I spent my time in doing non pharmaceutical works	2.69	Moderate
2	I cannot accommodate patients' demand due to lack of pharmacist or personnel on duty	3.34	Moderate
3	I am required to meet quota in dispensing medicines to increase the sales	2.57	Moderate
4	I am well compensated given the professional responsibilities I carry	3.74	High
5	My training and seminar expenses are taken charge of the company	3.46	Moderate
6	I participated or attended continuing education program related to Pharmaceutical care field	3.66	High
7	The company sent me to trainings and seminars as part of my professional growth and responsibility enhancement	3.20	Moderate
8	The pharmacy has a POS (point-of-scale) system software for recording sales transactions, generating reports and managing inventory	4.31	Very High
9	I can access the internet for me to check any drug information to Initiatively give it to the patient or to address their clarification	2.54	Moderate
Mean		3.28	Moderate

Table 2 shows that under system challenges, most of the predictor variables have moderate results as reflected in the table with an overall mean score of 3.28. This explains that the workload of the community pharmacists usually involves doing non pharmaceutical works like dusting, cleaning and cashiering, and meeting quota sales. The lack of staff and moderate internet accessibility for drug information have lessen the medication counseling performance of the respondents as this would consume their time. According to McCann et al. (2010) as cited by Lea et al. (2012), in a study involving 30 Irish community pharmacists requiring them to record their activities for 12 days using a bleeper device, the pharmacists spent their time on professional activities such as dispensing, over-the-counter, counseling (49%), semi-professional activities like administration and money (31%) and non-professional activities like house work and rest (20%). In addition, a research by Al-Arifi (2014) has identified causes for major dispensing errors such as high workload (72.5%), lack of time (69.8%) and being a sole pharmacist (69.4%). Other variables that have shown moderate results are related to human resource policies like sending the respondents to trainings and seminars with all expenses paid by the company and motivating them to do counseling activities because they are ready to share the new updates toward their patients or clients.

In India, a study by Ramanath and Nagavi (2011) have mentioned that 81.8% of the pharmacists as participants haverevealed that the training program they received is very useful and informative. Also, 86.36% of the participants have agreed that attending continuing education seminar increased confidence in their services and helped remove barriers for patient counseling. On the other hand, using of point-of-scale (POS) system software got the highest result in which it encourages the respondents to offer counseling tasks due to fast recording transactions and inventory of purchased pharmaceutical products. This also coincides the assessment made by Christensen and Farris (2006) wherein the practice of community pharmacies in the

US are focused on increasing productivity and efficiency through technology and assistants. Further, Kreling et al. (2006), in a 2004 National Pharmacist Workforce Survey in the United States, more than a half have claimed that equipment and technology increased their level of productivity, quality of care, financial performance, and job satisfaction in the pharmacy.

Moreover, two variables such as attending continuing professional education and monthly compensation seemed to satisfy the respondents. There is career growth in attending professional seminars which highly motivates them to counsel. And respondents are mostly employed in chain drugstores which is usually a more established company and being single in status with less expenses accountability can give them higher salary satisfaction.

The next table presents the pharmacy environment as another variable on the extent of challenge that denotes the physical structure and working atmosphere of the pharmacy conducive for therapeutic interaction.

Table 3. Extent of challenges among community pharmacists in medication counseling in terms of pharmacy environment

Item #	Statements	Mean	Descriptive Equivalent
1	I have a designated consultation area for me in order to entertain patients' concerns or confidential matter	2.49	Moderate
2	I can encounter patients hesitant to ask questions because they don't want others to hear them	2.83	Moderate
3	The pharmacy has a patient waiting area	2.94	Moderate
4	I am having difficulty in interacting with my patients due to high counters or uncomfortable dispensary arrangement	4.26	Very High
5	I can move freely due to big space and proper arrangement of furnishings	3.97	High
6	I am having difficulty in talking with my patients due to noise	3.89	High
7	I am having hard time conversing with my patients due to lighting and ventilation	4.60	Very high
Mean		3.57	High

Table 3 has the overall mean of 3.57 which gives a high result for pharmacy environment challenges. The predictor variables that support this data are the high counters and uncomfortable dispensary designs and difficulty conversing with patients due to lighting and ventilation of pharmacy stores. These limit pharmacist-patient interaction as this would further gaps and hesitations on the part of the patient or client. Noise is an additional factor that affects counseling patients perhaps due to a non-airconditioned setting of the drugstores and is also caused by busy and crowded commercial streets. Likewise, with reference to the study on counseling patients on OTC drugs, physical barriers present a challenge for the pharmacist in patient interactions especially due to the occurring high counters which hinders eye contact and makes a pharmacist seem distant and not open for face to face communication (Ferreri, 2004).

In addition, the challenges in terms of pharmacy environment where the pharmacy has a patient waiting area, patients' hesitation to ask questions and a pharmacist's designated consultation area to entertain patients' concerns and confidential matter all obtained moderate results with mean scores of 2.94, 2.83 and 2.49, respectively. If these variables are not implemented or executed, it could minimize patient's interest to the establishment and widen the gap between pharmacist-patient communications which may impede treating health status of the patients.

Moreover, as mentioned by Al-Arifi (2014), that lack of privacy (62.7%), interruption (59.9%), noise (58.2%), insufficient technical resources (58%), and dispensary designs (54.4%) are major contributors for dispensing errors. On the other hand, having huge space and proper furnishing arrangements were rated high (mean score of 3.97) by the respondents as these contributes to do their tasks in counseling easily. In this case, the government agency that provides license to operate among drugstores should also look into the floor plan and physical structure requirement of drug establishments.

Meanwhile, table 4 below shows data for patient challenges involving patient awareness for counseling and their comprehension skills.

Table 4. Extent of challenges among community pharmacists in medication counseling in terms of patient challenges

Item #	Statements	Mean	Descriptive Equivalent
1	I encounter patients who personally look for me asking about their medications	3.69	High
2	I encounter patients asking for my opinion about health-related concern	3.49	Moderate
3	I encounter patients asking for my recommendation on medication without having to see a doctor	3.46	Moderate
4	I encounter patients asking help from me in assessing or solving medical complain	3.26	Moderate
5	I encounter patients who are confuse while I am giving instruction	3.03	Moderate
6	I encounter patients who gives inaccurate feedback when ask about the instructions given to them	3.03	Moderate
7	I encounter patient listening to me as I am discussing medication information to them	4.03	High
8	I encounter patient who wants to be accommodated immediately	2.11	Low
Mean		3.23	Moderate

Table 4 reveals an overall result of moderate which has a mean of 3.23. This explains that patients' level of awareness when it comes to the role of pharmacists as drug counselors are still not fully materialized. Pharmacists rarely encounter patients asking advises on cases of multiple drug therapy and lifestyle modifications about common illnesses like hypertension and diabetes. Some patients are not convinced when pharmacists explain to them the danger of antibiotic resistance and others view them as merely drug dispensers or drug sellers, unlike in advanced countries they are given the responsibility to help patients in quitting smoking habits, fighting obesity and checking their lifestyle that enhances their professional image as an important healthcare team member. Moreover, patients or clients approach the pharmacists to such degree of only asking simple information regarding the drug product like its availability, substitute brands, over-the-counter drugs and home remedies which reflected a high result with a mean score of 3.69. However, with regards to the patients'

perceptions of community pharmacy practice in UAE, 31% of the patients looked for community pharmacists for advice when facing drug-related problems. When patients were asked the reason for their choices, 8.3% said that doctors are more expert, and only 7% stated that pharmacists know all about medications. Also, most patients came to pharmacy to get either post oral medications, or OTC medications. Then, patients claimed that location plays a main reason for visiting community pharmacy (Al Akshar, 2014).

In the study conducted by Wilbur et al., (2010), almost 1 in 7 did not know that medical complaints could be assessed by a pharmacist (15.3%) and 1 in 5 (21.9%) were not aware that certain medications can be safely suggested by a pharmacist without having to see a physician. However, key findings were noted in an eight focus-group discussions in California participated by senior citizens, physicians and community pharmacists that all participants agreed that pharmacists are a good resource for medication information and mostly confided first to the pharmacists before contacting the physicians. Physicians recognized the ability of pharmacists to identify drug-interactions but hindered by time constraints (Tarn et al., 2012).

Additionally, other factors that moderately affect the medication counseling of pharmacists are facing patients who are confused in instructions given to them and patients who give inaccurate feedback when asked about the instructions. This concludes that most of the patients are not medically inclined so they find it difficult to assimilate pharmaceutical terms, some have limited literary skills, while various patients' disabilities especially for senior citizens and maybe others did not comprehend well all the doctor's instructions. Thus, pharmacists in the community setting should be creative in finding ways for medication instructions by also giving written counseling in order to increase medication adherence.

As stated by Alkatheri and Albekairy (2013), patients with lower educational attainment can also be a counseling barrier as it affects the medication knowledge. Time and lack of demand and expectation from consumers were also reported by some pharmacists as barriers (Eadas et al., 2011). In addition, Ngoh (2009) claimed that the health literacy could be a potential barrier to pharmacist-patient communication and medication adherence. It was mentioned that most individuals with insufficient education are often embarrassed and kept their inability to understand medical information. Lastly, the respondents faced only few patients who wanted to be accommodated immediately as reflected by low score, this maybe was due to priority number imposed (first come, first served basis) on patients. If patients are not in a hurry then the pharmacist could give time for counseling.

Furthermore, table 5 below refers to the pharmacist challenges which discuss their confidence level in giving medication counseling accuracy.

Table 5. Extent of challenges among community pharmacists in medication counseling in terms of pharmacist challenges

Item #	Statements	Mean	Descriptive Equivalent
1	I am comfortable in approaching patient	4.29	Very High
2	I am unsure of my answers whenever patients will ask me	3.77	High
3	I am afraid that the patient will ask questions that I cannot answer	3.71	High
4	I worry about not being able to provide all the information that may be required	3.17	Moderate
5	I am having difficulty of keeping abreast of current drug information	3.40	Moderate
Mean		3.44	Moderate

Table 5 reveals an overall result of moderate equivalent to a mean score of 3.44. The result is contributed by the following variables: pharmacists find it hard to be updated with the current drug information with a mean score of 3.40 and pharmacists worry when patients ask questions that they cannot provide answers and all needed information with a mean score of 3.17. The challenge describing pharmacists as being unsure of their answers to their patients or clients resulted to a high result with a mean score of 3.77. The probable cause of this is most likely due to the insufficient clinical background training and knowledge on pharmacotherapeutics.

It has been admitted by pharmacy educators that pharmacists need continuing education program and must be supported by pharmacy owners to specialize counseling services. Pharmacy curriculum needs to be enhanced as well wherein specialization in the community setting should be offered. Hence, restrictions on doctor dispensing, patient counseling legalization and frequent offering of continuing professional seminars are factors that could enhance pharmacists in performing patient counseling. This result can be compared by the study of Al-Hassan (2011) where 81% of the community pharmacists in Saudi Arabia believed that counseling improves their knowledge and abilities, 84% believe that it increases job satisfaction and over 90% agreed that medications should be taken correctly because it enhances patient compliance. Nevertheless, approaching patients or patient-facing role is indeed considered the best positive strength of the respondents as they feel comfortable entertaining patients or clients.

In the study about performance of community pharmacists in providing clinical medication reviews in England, 37 community pharmacists completed clinical pharmacy training to provide medication reviews for elderly patients. The community pharmacists determined 75% of these drug-related problems and recommended 58% of the solutions. Although the pharmacists were self-selected, this study presented useful judgment to train community pharmacists in performing clinical medication review as part of counseling tasks (Laaksonen et. al, 2014).

Table 6 below shows the level of capability of community pharmacists in terms of knowledge. It is the capacity of each respondent in providing information to the clients or patients regarding medication therapy.

Table 6. Level of capability among community pharmacists in medication counseling in terms of knowledge

Item #	Statements	Mean	Descriptive Equivalent
1	Explain the dosage regimen and what to do if the patient misses the dose	3.69	High
2	Discuss the potential side effects of the drug and how to manage them in case if they occur	3.11	Moderate
3	Warn patients taking other medications or food in cases of interaction	3.29	Moderate
4	Give written materials to serve as instructions and provide information	3.23	Moderate
Mean		3.33	Moderate

Table 6 has the overall mean of 3.33 which gives a moderate result for level of capability in medication counseling in terms of knowledge. This means that the respondents provide information on the drug or any pharmaceutical products that the patients are taking or using but not sufficient enough to get all the necessary information. It is not easy for the respondents to provide all the drug background like discussing its side effects and how to manage them in case they occur, give warnings on which foods and drinks to avoid, or providing written instructions as they are also hindered by time constraints while the possible strong reason is that, further trainings and specializations are needed. However, one variable got a mean score of 3.69 which yields high referring to pharmacists explaining the dosage regimen as this can be seen in the prescription and that they already hold sufficient knowledge for non-prescription drugs. A study presented by Adepu and Nagavi (2009) unveiled that major barriers for counseling refers to pharmacists' inadequate knowledge and confidence (78%), inadequate continuous professional education (75%), and having no professional fee (56%). Also, many respondents agreed that, patient information leaflets certainly help in counseling but available information leaflets are company-generated and prescriber-focused.

The next table discusses the attitudes of the respondents which refer to their capacity of providing additional services to their patients or clients.

Table 7. Level of capability among community pharmacists in medication counseling in terms of attitude

Item #	Statements	Mean	Descriptive Equivalent
1	Summarize by emphasizing key point of the information	3.80	High
2	Help patient to plan and follow-up the next step for their medication	3.40	Moderate
3	Use open ended questions to the patient	3.49	Moderate
4	Provide patients an opportunity for final concerns or questions	3.69	High
5	Discuss life-style modifications	3.23	Moderate
6	Check patient understanding by asking to repeat back key information	3.23	Moderate
Mean		3.47	Moderate

Table 7 reveals a moderate result equivalent to a mean score of 3.47. This shows that the community pharmacists cannot always offer additional services such as guiding patients for the next step for their medication, using open-ended questions which show concern of what the patient is going through, discussing life-style modifications (especially in cases of diabetes, smoking, obesity and hypertension etc.) or by checking patients' understanding on their medications. These are sometimes hindered by time constraints, knowledge in giving additional information and perception that it is more of a physician's responsibility. In the study of Eadas et al. (2011), consumers viewed pharmacists as appropriate providers of public health advice but had mixed views on the pharmacists' ability to do this. Satisfaction was found to be high in those that had experienced pharmaceutical public health.

Table 8 presents the level of capability among the respondents in medication counseling in terms of practices. This refers to the capacity of the community pharmacist to perform their expected routine tasks.

Table 8. Level of capability among community pharmacists in medication counseling in terms of practices

Item #	Statements	Mean	Descriptive Equivalent
1	Discuss the need and indication of the medication to the patient	3.83	High
2	Discuss the medicine storage recommendation to the patient	3.63	High
3	Use the language patient likely to understand	4.54	Very high
4	Tell due back for refill when necessary	3.69	High
5	Tell the duration drug therapy	3.83	High
Mean		3.90	High

Table 8 shows a high result with a mean score of 3.90. It clearly proves that community pharmacists carry out their expected tasks mostly such as telling the drug's uses, storage recommendation due for refill and duration drug therapy within the premises. Their number one strength is by directly communicating with the patients in an understandable manner to address patients' concerns. Furthermore, in the study of the medication counseling among drug dispensers in Ethiopia by Wabe et al., (2011), 67.2% of them never ask symptoms for OTC drug buyers, 51.6% tell expected outcome therapy while only 4.7% of the dispensers tell common adverse effects and 3.1% give correct storage instructions. Inadequate drug knowledge and updated drug information were the top factors that discourage the dispensers from patient counseling. With this, the transformation of the orientation on the role of pharmacists is quite a long process and perhaps the most challenging issue faced by the Philippine Pharmacists Association (PPhA). Thus, the new Pharmacy Law and the demands of the ASEAN integration to standardize pharmacy practice will improve the counseling services if strictly mandated by the government.

Table 9 below shows the significant difference on the capabilities of community pharmacists in terms of knowledge, attitude and practices on patient medication counseling when analyzed according to age.

Table 9. Testing the level of capability of community pharmacist in performing patient medication counseling by age

Medication Counseling Capabilities	Age Category				F-value	p-value	Decision on Ho
	21-30	31-40	41-50	51& above			
Knowledge	3.36	3.10	3.54	3.08	0.350	0.790	Accepted
Attitude	3.52	3.46	3.31	3.50	0.245	0.864	Accepted
Practices	3.90	3.88	3.83	4.07	0.119	0.948	Accepted
Overall Mean	3.59	3.48	3.56	3.55	0.059	0.981	Accepted

Results of the statistical analyses revealed that there is no significant difference ($p>0.05$) on the level of capability among community pharmacists in medication counseling when tested according to age. This means that regardless of different age levels, the respondents do their duties by giving drug information, additional services and favors and carrying out their expected tasks as medication counselors. According to Mumtaz (2010) as cited by Shiveley (2013), altruistic behaviors towards co-employees decreases as age increases because senior or older workers tend to focus more on their work to avoid giving an impression that their performance is decreasing.

Table 10. Testing the level of capability of community pharmacist in performing patient medication counseling by gender

Medication Counseling Capabilities	Sex		t-value	p-value	Decision on Ho
	Male	Female			
Knowledge	3.21	3.35	0.394	0.696	Accepted
Attitude	3.21	3.51	0.853	0.394	Accepted
Practices	3.67	3.95	1.137	0.244	Accepted
Overall Mean	3.39	3.50	0.762	0.474	Accepted

Results of the statistical analyses revealed that there is no significant difference ($p>0.05$) on the level of capability among community pharmacists in medication counseling when tested according to gender. This means that both male and female community pharmacists provide medication counseling to their clients indicating their capacities in terms of knowledge, attitude and practices. This seems to confirm the study of Osarenren and Ogunleye (2009) that both male and female professionals have the ability to carry out their works in the same way which shows high regards to their chosen fields.

Table 11. Testing the level of capability of community pharmacist in performing patient medication counseling by civil status

Medication Counseling Capabilities	Civil Status		t-value	p-value	Decision on Ho
	Single	Married			
Knowledge	3.24	3.46	0.804	0.427	Accepted
Attitude	3.49	3.44	0.286	0.776	Accepted
Practices	3.87	3.96	0.481	0.634	Accepted
Overall Mean	3.53	3.62	0.494	0.625	Accepted

Results of the statistical analyses revealed that there is no significant difference ($p>0.05$) on the level of performance among community pharmacists in medication counseling when tested according to civil status. Both married and single pharmacists used their capabilities in terms of knowledge, attitude and practices in medication counseling to serve better their clients or patients despite their personal and family life challenges.

Table 12. Testing the level of capability of community pharmacist in performing patient medication counseling by length of service

Medication Counseling Capabilities	Length of Service				F-value	p-value	Decision on Ho
	5 & below	6-10	11-15	16 & above			
Knowledge	3.38	2.75	3.00	3.42	0.481	0.698	Accepted
Attitude	3.51	3.08	3.42	3.44	0.406	0.746	Accepted
Practices	3.91	3.30	4.00	4.20	1.179	0.333	Accepted
Overall Mean	3.60	3.04	3.47	3.69	0.790	0.509	Accepted

Results of the statistical analyses revealed that there is no significant difference (p>0.05) on the level of performance among community pharmacists in medication counseling when tested according to length of service. This means that both newly hired pharmacists have similar capacity when compared to other senior pharmacists in providing medication counseling to their clients. According to Avioli (1990) as cited by Shiveley (2013), the length of experience that the employee has is a better predictor of work performance than age. Thus, older employees are as just as good with the new ones due to the experiences they gain throughout the years.

Table 13. Testing the level of capability of community pharmacist in performing patient medication counseling by type of pharmacy

Medication Counseling Capabilities	Types of Pharmacy		t-value	p-value	Decision on Ho
	Independent	Chain			
Knowledge	3.58	3.14	1.650	0.108	Accepted
Attitude	3.54	3.42	0.721	0.476	Accepted
Practices	4.08	3.77	1.733	0.092	Accepted
Overall Mean	3.74	3.44	1.729	0.093	Accepted

Results of the statistical analyses revealed that there is no significant difference (p>0.05) on the level of performance among community pharmacist in medication counseling when tested according to types of pharmacy. This means that both types of pharmacy stores have their own mechanism in providing medication counseling to their clients. However, in the study conducted by (Mott et. al, 2004) pharmacists working in independent establishments most likely have high job satisfaction level due to less stress from company demands and workloads which made them to exercise their duties as pharmacists.

Table 14. Correlation analyses between the challenges encountered by community pharmacists and performance in patient medication counseling

Challenges (x)	Performance (y)	r-value	p-value	Decision on Ho
System Challenges	Knowledge	-0.028	0.872	Accepted
	Attitude	-0.028	0.872	Accepted
	Practices	0.053	0.763	Accepted
Pharmacy Environment	Knowledge	0.059	0.375	Accepted
	Attitude	-0.047	0.789	Accepted
	Practices	0.041	0.813	Accepted
Patient Challenges	Knowledge	0.254	0.141	Accepted
	Attitude	0.321	0.060	Accepted
	Practices	0.103	0557	Accepted
Pharmacist Challenges	Knowledge	-0.222	0.200	Accepted
	Attitude	-0.092	0.599	Accepted
	Practices	-0.230	0.185	Accepted
Overall Mean	Knowledge	-0.003	0.998	Accepted
	Attitude	0.051	0.773	Accepted
	Practices	-0.078	0.656	Accepted
	Overall Mean	-0.012	0.947	Accepted

The results in table 14 clearly indicate that the four challenges considered (system challenges, pharmacy environment, patient challenges and pharmacist challenges) have low correlation to the patient medication counseling capabilities in terms of knowledge, attitude and practices of community pharmacists. This suggests that most of the respondents knew that part of their duties and responsibilities despite those challenges encountered particularly on incentives, policy changes, human resource issues and on doing administrative tasks such as dispensing; physical structure and working atmosphere; patient awareness on counseling and comprehension skills; and confidence level in giving medication counseling accuracy to provide patients or clients medication counseling and effectively sustain pharmaceutical care by exhausting their capabilities in providing information, extending services and carrying out routinely tasks.

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International Journal of Education Research for Higher Learning *Print ISSN 1656-0604*
Vol. 22 No. 2 October 2016 *Online ISSN 2244-6532*

Arne Naess' Ecosophy: Exploring the Overlap between Philosophy and Ecology

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ABSTRACT

This paper deals with following queries: (1) What is ecosophy? and (2) What type of overlap subsists in an ecosophy? The first query revolves around Naess' position in ECL, which is the expository part of the paper, and the second question involves an analysis on the nature of overlap that subsists between philosophy and ecology in Naess' ecosophy. Guided by the expository-analytic approach in philosophical writing, this paper has come up with its set of analyses and reflections, which can hopefully remind humanity of his/her role in upholding the value and intricacies that can protect the environment from further damage, and perhaps cultivate thinking and practical conditions that can redirect humanity's relation with nature, and remind each person of his/her originary link with the environment. In conclusion, this paper advances that ecosophy can be construed as an overlap between philosophy and ecology. On this note, having an ecosophy means that its interface is that of the reconstituting type because: (1) a person develops a philosophical total-view shaped through the continuous rethinking of man's proper relation to nature, (2) an individual utilises yet evaluates scientific information in the light of his total view, and (3) the philosophical world-view of humanity's rightful place in nature and the evaluated information provided by science, serve as a presupposition for a person to act in facing and responding to the challenges of protecting and nourishing life in the ecosphere. Also, it is paradoxically both a symbolic and mitigating overlap, since an ecosophy reminds humanity of his/her capacity to live in harmony with nature – pertaining to symbolic overlap, and his/her presence in the environment, however remains tension-filled given that it is still unclear as to why humanity is yet to categorically decide on his/her stance on the value of the environment and humanity remains oblivious of his/her role in the over-all scheme of things in nature.

KEYWORDS: Philosophy, ecology, Arne Naess, Naess' ECL, ecosophy, expository-analytic approach, Philippines

INTRODUCTION

Rothernberg describes an interesting turn in Arne Naess' lecture somewhere in Oslo. He said: "After an hour he suddenly stops, glances quickly around the stage, suddenly leaves the podium and approaches the potted plant to his left. He quickly pulls off a leaf and scurries back to the microphone, and gazes sincerely at the audience as he holds the leaf in the light so all can see. *You can spend a lifetime contemplating this*, he comments. *It is enough. Thank you.*"[1] Naess' actuation in his lecture provides a glimpse of his disposition towards nature and the status of the environment. While the present environmental problems occasion man to feel gloomy of his future and the future of the planet,[2] humanity's experience with the natural environment can also be coupled with joy – the satisfying, fulfilling and joyful moments that an individual may encounter, while spending time or being with the natural environment.[3] With such enabling disposition, a crucial current concern for humanity is to study and reflect on his/her relationship with nature, however.[4] The present environmental catastrophes, for instance, offer an opportunity for humanity to rethink and reconfigure his position in the environment, motivate him/her to clarify his/her ways of looking at and dealing with nature, and encourage him/her to make a choice not only for one's self but also for nature as a gestalt – as an experience of the whole.[4]

With the debilitating conditions confronting the environment, Naess specifies that in today's environmental problems, a modest way of living with nature is needed and humanity needs to be reminded that he/she as intricately inseparable from the network of relations that constitutes the environment. Naess further elaborates what modesty means based on a certain experience of nature: "Modesty is of little value if it is not a natural consequence of much deeper feelings, a consequence of a way of understanding ourselves as part of nature in a wide sense of the term. This way is such that the smaller we come to feel ourselves compared to the mountain, the nearer we come to participating in its greatness."[6] To secure such form of modesty, intimately understand humanity's role in the environment, and reverse the seemingly inevitable catastrophic future of the planet, *Naess' Ecology, Community and Lifestyle* (hereafter, ECL) invites

[1] Arne Naess, Ecology, Community and Lifestyle: An Outline of an Ecosophy (hereafter, ECL), trans. David Rothenberg (New York: Cambridge University Press, 1989) 7.

[2] Ibid., 1

[3] Ibid.,.51.

[4] Ibid., 2.

[5] Ibid.,26.

[6] Ibid., 3.

individuals to develop and articulate personal ecosophies. It is an invitation grounded upon an earnest hope that humanity may actualise his/her potentials to care for nature and develop abilities to delight in the living and intricate diversity of the environment.[7]

In philosophically unpacking Naess' invitation and challenge, this paper deals with these queries: (1) What is ecosophy? and (2) What type of overlap subsists in an ecosophy? The first query revolves around Naess' position in ECL, which is the expository part of the paper, and the second question involves an analysis on the nature of overlap that subsists between philosophy and ecology in Naess' ecosophy. For the second query, it is enabled by the three types of overlap explored and laid out in an article, *"Epistemology of the Overlap II"*[8] to better describe the conceptual relation between philosophy and ecology in an ecosophy. Guided by the expository-analytic approach in philosophical writing, this paper has come up with its set of analyses and reflections, which can hopefully remind humanity of his/her role in upholding the value and intricacies that can protect the environment from further damage, and perhaps cultivate thinking and practical conditions that can redirect humanity's relation with nature, and remind each person of his/her originary link with the environment.

What is Ecosophy?

The uniqueness of ecosophy rests on the fact that it is a compound of two terms namely 'eco' and 'sophy'.[9] 'Eco' or 'oikos' in Greek means 'household' and is a prefix in the term ecology; and 'sophy' or 'sophia' in Greek which means 'wisdom' is found in the word philosophy. The integration of the two terms conditions this paper's curiosity to raise this sub-query: 'What is the meaning of 'sophia' and 'eco' in ecosophy?'. To address this sub-question of the main question – 'What is ecosophy?' the following tasks are to be accomplished: (1) articulate the side of philosophy in ecosophy; and (2) discuss the side of ecology in ecosophy. After dealing with the two sub-interests, hopefully, the question, 'What is ecosophy?' has been properly dealt with.

[7] Ibid., 24.

[8] Raymundo R. Pavo, "Epistemology of the Overlap II," Phavisminda Journal, 2016.

[9] Naess, ECL, 37.

Philosophy in Ecosophy

A short survey of the history of philosophy reveals that the term philosophy can have many meanings. For instance, one can observe that each philosopher gives an account of his own way of looking at and dealing with philosophy. The philosopher Arne Naess is no exemption to such an observation. Because the meanings that philosophers assign to philosophy are reflective of their personal views of life, the world, or reality, this section intends to closely look at these points: (1) Naess' interpretation of 'sophia' or wisdom in the word philosophy, (2) his description of the basic meanings of philosophy, and (3) Naess' reflection and discussion on the two meanings of philosophy in relation to ecosophy, and their relations.

Meanings of Sophia

Sophia or wisdom for Arne Naess pertains to these senses: (1) wisdom which values transparency over scientific pretension, (2) as insight which demands direct relevance to action, and (3) as that which intimate acquaintance with personal understanding rather than impersonal or abstract results.

Naess' first stance on wisdom values the importance of honesty or transparency in contrast to pretension. Transparency, in this respect, means being able to articulate uncertainties, and acknowledge areas of ignorance in any field of interest. For instance, science – when confronted with uncertainty, needs to admit the vast and unknown effects of their researches and experiments to the environment.[10] This meaning of wisdom, therefore, hopes that science will openly accept the limitations of its enterprise, and that humanity will also start to question the certainty, authority and significance conferred to science in modernity.

The second notion of wisdom compares it to a disposition that is always related to action.[11] This means that wisdom can only be as such when it actively looks for ways to make the 'sophical insight' concrete in actual states of affairs. In contrast to the ivory image tower of philosophy, such appraisal of wisdom requires philosophy to be directly relevant to action.[12] Conversely, action without

[10] Clive Ponting, The Twentieth Century, (New York: Henry Hall and Company Publishers, 1999) 75.

[11] Naess, ECL, 1.

[12] Arne Naess, Alfred Ayer, and Fons Elders, "The Glass is on the Table: The Empiricist versus Total View," Philosophical Dialogues (hereafter, PD), ed. by Nina Witoszek and Andrew Brennan, (New York: Rowman & Littlefield Publishers, 1999) 26.

underlying wisdom is useless. On this note, action must be consistently guided by a 'sophical insight'. Through the intimacy between with action and wisdom, daily decisions, even conversations and discussions, become reflective of the 'sophical insight'. As Naess remarks: "I feel that as a philosopher I am an acting person, not an abstract researcher."[13]

The third stance on wisdom points to the process of integrating an individual's understanding of and acquaintance with the environment. Acquaintance here means a person's actual way of relating with nature, while understanding refers to man's conceptual way of perceiving nature. On this consideration, Naess' idea is for both acquaintance and understanding to coalesce and form a productive pair, and perhaps address the gap between a person's way of looking at nature and the actual way of dealing with the life forms[14] in the environment. This sense of wisdom is reflected in an experience of Naess together with and conveyed by Rothenberg in the breeding ground of wild elephant seals in Santa Cruz: "They (the seals) do not notice the intruder (Naess), his identity so fused with theirs in the darkness that there is no line. The world emerges and looks at the world, only to return to it once and for all in the end. Night falls on the beach of Ano Nuevo, and the philosopher and nature are one.'[15]

Meanings of Philosophy

For Naess, philosophy can mean two things: First, philosophy is a field of study, an approach to knowledge; and second, philosophy is a personal code of values and a view of the world which guides one's own decisions.

The first meaning presents philosophy as an academic study in a University.[16] The university is where students and philosophy teachers discuss themes and topics belonging to the discipline of philosophy – most fundamental and profound. According to Naess: "Philosophy belong the most profound, the deepest, and the most fundamental problems. They will change very little, and they have not changed much over the last two thousand years…the epistemological question, "what can we know?" and the ontological one, "what kinds of things are there?" belong to philosophy. As I see it, they are among the most profound questions we

[13] Ibid., 24.

[14] Naess, ECL, 29. The term life is used here in a comprehensive non-technical way to refer also to things biologists may classify as non-living: rivers, landscapes, cultures, ecosystem.

[15] David Rothenberg, "The life of Arne Dekke E. Naess: From Mountain top to the Depths of Ecology," Environmental Ethics: Discourse and Cultural Traditions, A Festschrift to Arne Naess (hereafter, EDF), 21.

[16] Arne Naess, "Ayer on Metaphysics: A Critical Commentary by a Kind of Metaphysician," PD, 38.

can ask."[17] More to the point, Naess in his public debate with Ayer, he specifies an important concern of philosophy as a field of study. Aside from asking profound questions, philosophy and philosophers should also be concerned with the task of connecting views.[18] This responsibility implies philosophy should aim to gather and see the perspectives from other academic disciplines, and as opportunities for discovering and learning new insights.

For the second meaning of philosophy, Naess construes the realm of philosophy as a position or point of view, or as guide to responsible decision-making.[19] For this meaning, Naess is emphasizing two interrelated concerns: (1) An individual has the task of formulating and becoming aware of a code of values which he/she has been carefully and personally reflected upon, and (2) when confronting the world, Naess says that the personal code of values needs to implicitly grounded or rooted upon a world-view or total-view.[20] For the second Based on the implicit total view, he encourages individuals to situate decisions in the total field of relations. Rothenberg also talks on Naess' idea of total view, he says: 'Naess believes that we always act as if we possessed a total view – that is, an implicit vision of how we fit into the world.'[21]

Between Eco-philosophy and Ecosophy

One of the fields of study in philosophy, which is important for Naess, is ecophilosophy. As to what eco-philosophy is and stands for, he underscores three habits usually associated to it as sub-discipline which are telling of eco-philosophy's basic dispositions: (1) it is a field of study in a university, (2) it is value-neutral, and (3) it seeks to examine a particular kind of problem between philosophy and ecology.[22]

Eco-philosophy, as a field of study proper to the university, stands for a brand of thinking which directs its sense of wonder to gestalts or networks of relations in the environment.[23] This object of interest is what separates eco-philosophy from other concerns or interest in other branches in philosophical investigations. The neutral character of eco-philosophy means that it has the tendency of not making

[17] Naess, Ayer and Elders, PD, 11.
[18] Naess, ECL,14.
[19] Ibid., 38.
[20] Ibid.
[21] Rothenberg, EDF, 16.
[22] Naess, ECL, 36.
[23] Ibid., 57.

or committing to a choice between value priorities, however. Naess says that it is in this domain where the practice of eco-philosophy can still improve.[24] Despite its weakness, Naess thinks that its contribution rests on its emphasis for the deep process of questioning, which entails continuous exploration, uncovering roots or pre-suppositions of ways of thinking in ideologies and value priorities. The need to improve eco-philosophy's habits is tied to its next feature: its inter-disciplinal relation with the science of ecology. In this respect, eco-philosophy is a "field of study which utilizes the basic concepts from the science of ecology – such as complexity, diversity and symbiosis – to clarify the place of the species of humanity within nature." This is where Naess' notion of relational thinking also hinges its distinct approach endorsed as the ideal and practical activity of the human mind.[25]

But when philosophy as a position or point of view is applied to questions involving humanity's relation to nature, Naess terms such form of philosophy as ecosophy. More specifically, Naess defines ecosophy as "a personal philosophical world-view or system inspired by the conditions of life in the ecosphere."[26] Naess further explains that ecosophy has two interrelated purposes: (1) as an individual's philosophical grounding for the acceptance of the principles or platform of the deep ecology movement,[27] and (2) as personal approach to practical situations involving the environment and ourselves.[28] In the articulation of an ecosophy, Naess hopes that it will lead an individual to clarify his/her attitudes towards nature and hopefully discover one's self as deeply connected with the milieu. Such a discovery of one's self as deeply connected with nature is hoped to inspire humanity to protect and nourish the ecosphere.[29]

In *Ecology, Community and Lifestyle*, Naess articulates his ecosophy, which is called Ecosophy T. The letter T stands for Tvergastein – the mountain hut of Arne Naess.[30] In presenting Ecosophy T, he is encouraging individuals to discover and formulate their own personal ecosophies or a point of view on nature that is most meaningful for them, or an ecosophy where one philosophically belongs and is at home with.[31] As Rothenberg aptly frames the process of articulating a personal ecosophy, it is like "ascending the same mountain perhaps, but choosing

[24] Ibid.,13.
[25] Ibid.,79.
[26] Ibid., 38.
[27] Ibid.,.38.
[28] Ibid., 37.
[29] Ibid., 80.
[30] Rothenberg, EDF, 13.
[31] Naess, ECL, 37.

the way most appropriate for each individual climber."[32]

Ecology in Ecosophy

The term ecology is a compound of two Greek terms, namely: 'eco' or 'oikos' which means household; and 'logos' which means to study. Literally, ecology means the study of a household.[33] In Naess' understanding, the prefix 'eco' has a broader meaning than household, since he also classifies it as synonymous to terms like immediate family and community. For him, 'eco' means Earth household,[34] which he considers closer to the notion of relations within a household.

The Science of Ecology

Ecology, as a scientific discipline, is one of the three fields of study in biological research.[35] More specifically, Naess defines ecology as "the scientific study of the living conditions of organisms in interaction with each other and with the surroundings, organic as well as inorganic."[36] The aspect of ecology, which Naess considers most important is ecology's primary concern with relationships between entities. In view of ecology's scientific character, Naess says that ecology serves as a repository of information on the living conditions of life forms. This archival purpose, however, needs to be cautioned, since ecology should never be considered as universal science. Otherwise, such stance will only result in ecologism or the excessive generalisation of ecological concepts and theories.[37]

To further explain his stance as to why ecology should not be universalised, the following evaluations concerning science needs to be considered: Naess points out that the science of ecology is not capable of denouncing processes. This means that it has only been involved in the giving of 'facts' or statements that present how entities function. More than a functional approach, it must include the important role of announcing values. For instance, Naess observes that the science of ecology, like chemistry, and physics only acknowledge change but not valued-change. This is why Naess underscores the need for evaluative thinking

[32] Rothenberg, EDF, 19.
[33] Warwick Fox, "Deep ecology: A New Philosophy of Our Time," PD, 155.
[34] Naess, ECL, p.37.
[35] Ibid., 35.
[36] Ibid.,36.
[37] Ibid.,.39.

in science by raising, for example, these questions: What do human beings really want? How can such goals or ambitions be realised without sacrificing the integrity of the environment? Given these sample queries, Naess remains optimistic that humanity may realize that scientific statements have been taken in isolation, and scientific knowledge would need to be approached with critical lens especially with its relation to uncertainties, and its not so healthy disposition with its flaws and limitations.[38]

Moreover, scientific processes have implicit and ultimate assumptions of a philosophical kind.[39] This is another feature of science that needs attention and consideration. Examples of these philosophical assumptions are answers or positions to questions like: Is it good for what it is said to be good for? In what does the good consist in the instance investigated, etc? Naess says that science is yet to substantially contribute to the possible meaning and relevance of such queries.

Objectivity in Science

Science is generally regarded as an objective field of study. But does Naess consider science an objective discipline? In ECL, Naess defines objectivity as "a way of conducting a research or study where 'evaluations' are explicitly formulated."[40] In this respect, each field of study can articulate an evaluation only if the discipline is able to express its philosophical assumptions. This is where science, according to Naess, fails.

In Naess' definition of objectivity, two types of statements are in need of distinction: (1) descriptive statements, and (2) prescriptive statements.[41] On the one hand, a descriptive statement is non-normative. As statement, its main purpose is to articulate an observation on a specific field of investigation; it does not present an evaluation. For instance: The erosion of soil forests endangers the capacity of the earth to grow trees in the future. In this example, the statement only presents the relationship between 'the capacity of the earth to grow trees' and 'erosion of soil forests'. The example does not say that the soil forests must be protected. On this note, the descriptive statement is what Naess classifies as hypothesis, which he considers as statements habitually formulated in science.

[38] Ibid., 24-26.
[39] Ibid., 40.
[40] Ibid., 40.
[41] Ibid., 42.

A prescriptive statement, on the other hand, motivates individuals to think, formulate personal positions, and perform actions. As statement, it expresses an evaluation or articulates a value judgement: for example – diversity of life forms is good. The important feature of a prescriptive statement is it fulfils a normative role: diversity of organisms! In Ecosophy T, all normative statements are followed by an exclamation mark. Based on the given example, statements that are normative in kind accomplishes two points: (1) it articulates a prescriptive statement, that diversity of life forms is good, and (2) it demands humanity to perform concrete actions which means taking care of and protecting such diversity. Thus, the absence of the normative statement results in the non-existence of a principle for action. If all statements about the environment are descriptive, no actions or decisions can be made for the protection of the environment.

Following the normative stance, a norm serves as a guideline that is subject to what Naess terms as precisation. Precisation is not the rejection of norms but the process of introducing expanding alternative interpretations of a point of departure. An example of a point of departure is 'Self-realisation!'. When Naess begins his Ecosophy T with the norm 'Self-realisation!', the normative statement allows many individuals to associate or relate with the starting point. These associations refer to alternative interpretations or interpretations that other individuals may formulate. The normative statement, 'Self-realisation!' is meant to expand the understanding of the self to include all life forms in the environment and not to confine it to the perspective of one individual.[42]

Conservation Biology

Naess says that conservation biology is an example of a scientific discipline that combines both normative and descriptive statements.[43] Specifically, conservation biology refers to the "collage of disciplines applied in an effort to understand, characterise, and protect biodiversity in the human dominated environment." The combination of prescriptive and descriptive statements in conservation biology, according to Naess, has paved the way for its substantial reorientation. Rothenberg affirms such reorientation, when he explains that: "Scientists, long influenced by a self-imposed taboo against involving ethics in the pursuit of truth, have finally begun to come around and realize that their

[42] Ibid.,6.
[43] Ibid.,46.

work is deeply intertwined in a system of values, which they should use their expertise to articulate." The four norms of conservation biology are as follows: (1) diversity of organism is good, (2) ecological complexity is good, (3) evolution is good, and (4) biotic diversity has intrinsic value.[44]

The four norms hold that each species is considered vital or an essential component in the total field of relations in the environment. If a person reflects on the four norms of conservation biology, Naess claims that it is not far for an individual to recognize that 'anthropogenic' or human-made/non-natural structures may threaten the survival of a group of species. Consequently, humanity may realise that there is a need to seriously and critically protect certain areas in the environment from human intrusion. Naess points out that the four prescriptive statements of conservation biology have helped in the formulation of recommendations and decisions in favor of the environment even before scientific investigations had started.[45]

But Naess also stresses that such norms can still be reformulated to make them more general. The reformulation of the norms of conservation biology is intended to elicit wider associations or alternative interpretations from more individuals. This is an example of a norm in conservation biology which is made more general: 'Biotic diversity has intrinsic value' reformulated to 'Life form diversity!'. The phrase 'biotic diversity' is made general in 'life form diversity!' as the term 'life form' refers to all entities in the environment including landscapes, watersheds, cultures, etc, while biologists may consider cultures as non-living entities, which are not included in the norm 'biotic diversity'.

Ecosophy as Overlap?

The relation between ecology and philosophy in ecosophy may be construed as an instance of the overlap. Following the three forms of overlap as mitigating, reconstituting and symbolic, the kind of interface that subsists in an ecosophy uniquely crosses the three types of overlap as reconstituting, symbolic and mitigating. In Epistemology of the Overlap, a reconstituting stance means that the interfacing elements – in this case, ecology and philosophy, contributes something to both disciplines in such a way that the interface creates and cultivates an output which can eventually stand for its own meaning.[46] This

[44] Ibid., 46.
[45] Ibid.
[46] Pavo, "Epistemology of the Overlap," 3.

sense of autonomy is what Naess' Ecosophy T accomplishes, since it has gained a perspective which philosophy and ecology – when taken individually, may not be able to generate. More to the point, ecosophy overcomes the limited and unclear value commitment of traditional speculative philosophizing and ecology's functional take on the meaning and role of the environment. With Ecosophy T, Naess demonstrates that a commitment towards nature needs to be ascertained, and expressed. Complexity of life forms is good! This is what ecosophy demands from the interfacing fields of philosophy and ecology.

From a reconstituting stance, the next type of overlap in an ecosophy is of the symbolic kind. This means that when two elements interface, the overlap shows the context upon which the act subsists, thereby demonstrating how the context supports and conditions the derivative meaning and value of the act.[47] In this case, what is revealed in Ecosophy T is the sense of fulfilment or the experience of joy when one contemplates on the complexity and value of the environment. This is the capacity which Naess continuously underscores as humanity's way of rediscovering himself/herself as organically linked to nature. A good example for this type of act is his lecture in Oslo presented at the beginning of this article. It can be recalled that Naess, while giving a lecture, stopped and elected to pick a leaf and proclaimed that a lifetime is not enough to contemplate on the meaning of nature. In this case, the eco-philosophical gesture or act of contemplating on nature, reveals humanity's context as a thinking being via his being a student of ecology who can now showcase how the contemplative act is nourished by richness and complexity of the environment both as a reservoir of practical resources and moral values or principles.

Interestingly, the symbolic overlap in an ecosophy remains incomplete, since the contemplative joy in reflecting on and acting for nature is also indirectly enabled by the problems which the environment is facing. This means that while humanity can take heaps of insight and inspiration from nature, the destructive nature and implications of humanity's actions to nature also underscores the tension between human consumptive interests, and nature's integrity and worth. This is what the third type of overlap pertains to: mitigating overlap which is enabled by the tension between two acts or thoughts. This is where the coupling between philosophy and ecology is made possible by the tension itself, or the seemingly natural opposition between disciplines. In this case, an ecosophy may revert or rescind to the non-commital stance of eco-philosophy and ecology especially that in today's environmental problems, the unclear commitment of humanity with regard to his/her practical and integrative stance on the integrity of the environment dominates the kind of relation that humanity has with the environment. In mitigating overlap, is ecosophy simply a cover up of humanity's greed?

[47] Ibid., 5.

Conclusion

This study gained two interrelated insights: (1) An important concern for Naess is that of transcending ecology as a science, looking for wisdom in philosophy, while striving for an ecosophy as a total view inspired both by the science of ecology and philosophy. In ECL, such effort gained fruition in his notion of Ecosophy T being a form of action. This is where Naess' codification gains symbolic premium as it can be a starting point for a discussion among present and future ecosophers. It can also serve as ground for possible articulation of questions and reflections on humanity's relation with nature. This is why Naess' systematisation of his ecosophy is only one particular form. Other formulations of ecosophy may be expressed differently yet having the same content of his ultimate norm – 'Self-realisation!' yet presented in a different structure; and

(2) Ecosophy can be construed as an overlap between philosophy and ecology. On this note, having an ecosophy means that its interface is that of the reconstituting type because: (1) a person develops a philosophical total-view shaped through the continuous rethinking of man's proper relation to nature, (2) an individual utilises yet evaluates scientific information in the light of his total view, and (3) the philosophical world-view of humanity's rightful place in nature and the evaluated information provided by science, serve as a presupposition for a person to act in facing and responding to the challenges of protecting and nourishing life in the ecosphere. Also, it is paradoxically both a symbolic and mitigating overlap, since an ecosophy reminds humanity of his/her capacity to live in harmony with nature – pertaining to symbolic overlap, and his/her presence in the environment, however remains tension-filled given that it is still unclear as to why humanity is yet to categorically decide on his/her stance on the value of the environment and humanity remains oblivious of his/her role in the over-all scheme of things in nature.

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Jean-Paul Sartre and Gabriel Marcel Phenomenologies of Freedom: The Conception of Political Space on the Territorial Dispute Between China and the Philippines

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ABSTRACT

The history of the Chinese and Filipino people cannot be told enough because, although it has written records, new light is being shed on it as new archaeological facts are unearthed each year. Meanwhile the Chinese endure to make history. Many other civilizations have risen and fallen but China lives on. Whatever the factors are, it is always worthwhile to examine the record and see how the Chinese and Filipino people have traveled through the corridors of time with agility, resiliency and endurance. One can of course, approach such a venerable civilization by studying its charming customs and traditions, its enormous cultural legacy and its history. The history of the world sums up a story of colonization and liberation, namely, a conflict in territorialization. On the other hand, ultimate realization of the collaborative effort depends upon an enlightened exchange—an exchange that does not stop at externals, but penetrates to dynamic intentions. This effort maintains to understand and evaluate the phenomenologies of freedom proposed by Sartre and Marcel, however slightly, the progress of such an exchange, is not without excuse. Hence, this paper suggests that both countries need to go back and restore their original experience. There are for sure tough and immense difficulties in the discourse of who truly and rightfully owns the contested territory given pieces of evidences were presented from both sides. The point on the territory, thus, signifies Sartrean freedom, the negative one. Nevertheless, there are so much things can be explored by converging on the discourse of intersubjectivity. Here, both countries could look back that their relations was once under the climate of mutual trust and somehow sharing instead of dividing the space.

KEYWORDS: Freedom, existentialism, phenomenology, political space

INTRODUCTION

On July 12, 2016, the Permanent Court of Arbitration ruled in favor of the Republic of the Philippines in its territorial rift with the People's Republic of China, affirming the exclusive sovereign rights of the former as regards to the West Philippine Sea and invalidating, among others, the nine-dash line of the latter. China swiftly rebuked the decision and continued to occupy the contested area within the contentious lines it has drawn. Talks for a possible bilateral partnership between the countries are percolating. As to whether it will put a halt, if not heal this historic tussle, is yet to be seen. Meanwhile, this conflict which began since the dawn of the twentieth century continues to brew.

One concrete thing that can be derived from this picture is the crucial idea a territory occupies in the well-being and destiny of the state. While the ability to protect, territory highlights a state's credential in maintaining its sovereignty, one's ability to expand it demonstrates a state's power over others. This clearly indicates that territory is not just a parcel or collectivity of lands which individuals inhabit. As J Macgregor Wise (2008) succinctly puts it, territories are areas of power and influence. Hence, increasing territories (through whichever mode of acquisition) augments power and influence.

The history of the world may be summed up as a grand narrative of colonization and liberation, that is, a conflict in territorialization. This conflict re-echoes Harold Lasswell's pronouncement about "who gets what, when, and how" (Grigsby, 2008).

This study offers a fresh insight about the territorial dispute between the two countries. Sure, in the knowledge that the political and legal domains have already made their positions on the issue, this paper invites readers to bracket or suspend whatever prejudice they have and explore this issue not in the context of conflict but of freedoms.

The discussion will be generally divided in these parts: (a) the pre-colonial and mutual ties between China and the Philippines, (b) the birth of the nation-states (c) appraising the territorial dispute in the light of Jean-Paul Sartre and Gabriel Marcel's phenomenologies of freedom.

Revisiting the Pre-colonial and Mutual Ties between Chinese and the Philippine Polities

The ties between China and the Philippines extend far back. This tie began at least in 618 when we established contact with the Tang Dynasty. In 982, Ma-i, what now maybe regarded as Mindoro, brought goods to Canton (Abinales and Amoroso, 2005). Trade relationship between these countries was naturally open, punctuated by rich maritime activities. The seas were generally, and in most cases, regarded as common property. This sea, however, will later be contested either as South China Sea or West Philippine Sea.

The ancient and feudal China was said to be governed T'ien, an idea which means mandate from heaven. Under this idea leaders were appointed by God, roughly equivalent to the Western notion of the Divine Right of Kings or Divine Right Theory. In the Chinese conception, leaders are noble and benevolent. They cannot also abuse their power because people possess Geming, or the right to revolt.

> When political thought first appeared in China, a relative of the imperial house would invoke his duke for a mandate to rule. A king himself could only rue because he had received a mandate of Heaven. T'ien granted a mandate only to one king on earth, who then became known as the Son of T'ien, a title equivalent to 'emperor'. The title here carried no divine connotation but simply connoted filial duty of a son of his parents, which is obedience. Thus, although it prescribed one-man rule, the charge to rule was conditional. Should the son of Heaven become wicked, T'ien withdrew the heavenly mandate and punished the wicked ruler by choosing from among the people, the wisest and the most virtuous to receive the mandate of Heaven (Fung Yu-lan, 1952; p. 66).

Despite the supposed noble, benevolent, and limited character of political rule, this pre-colonial polity was governed by the idea that the world is a single unit, with China located at the center of this world. This belief presupposes not only the China's dominance but also the impracticality of territorial delineation as it would lessen the encompassing nature of universal authority (Sassot, 2017).

> Moreover, the threat of Geming (or revolution), which literally means "to change the mandate," was already imbedded in ancient Chinese political consciousness. Consequently, the Divine Right of Kings became forever insecure and undependable. It may be said that the Chinese Emperor only enjoyed theoretical fame for the pulse of the people became the very censure of his imperial behavior… "Heaven hears and sees through the people. Heaven expresses its disapproval through the expressed disapproval of our people… This literally made the voice of the people also the voice of Heaven (Fung Yu-lan, 1952; p. 68).

Establishing tributary relations was also demonstrative of the dominant status of Chinese rulers as the Son of God. Tributary visits of foreign visitors were punctuated by elaborate rituals. Ringmar (2012) described this ritual:

> Paying tributes and performing the kotou were part of this ritual. During the kotou, delegates of the tributary mission kneel three times and prostrate nine times before an emperor seated on "a throne placed on an elevated platform […] The ritual performed during tributary visits was the way for foreigners to acknowledge "the cultural supremacy of China" and to express their gratitude "to the emperor for his role in maintaining the cosmic order." In return, the emperor recognized the legitimacy of the rulership of the foreign leaders. It is important to note that the polities headed by these leaders "did not become colonies or part of the imperial administrative system: they were simply enrolled as independent states now occupying their proper niche in the Chinese cosmic order." Thus, though the Chinese ruler viewed himself as ruling at the centre of tianxia, he "did not claim sovereignty over [the] system as a whole…[T]he constituent units were free to carry on their affairs much as they please"

Standing in sharp contrast with China is the Philippines. According to Abinales and Amoroso (2005), the archipelago did not constitute a single, recognizable polity according to the annals of the10th century and even in 16th when it received its name in honor of the Spanish monarch, Philip. Albeit there was no singular, monolithic entity called the Philippines, it may be appropriate to

regard this archipelago as a plurality composed by a plethora of kinship networks, rajahnates, chiefdoms, sultanates. (Woods in Sassot, 2017) Other systems also exist in the southern part of the country like the so-called government with the Timuay at the apex of the structure.

Kinship is considered as an important element that binds communities together. It creates a bond that ensures political and social significance since two leaders enter into a pact to recognize each other as brothers. Kinship can also be strengthened through blood compacts, marriages, and other rituals (Abinales and Amoroso, 2005).

Despite the lucid social differences, ties between these countries lasted for centuries. In fact, this could be observed across the major phases of the Philippine experience: precolonial, colonial, and post-colonial period. Tributary relations and kinship may have been the necessary social forces which made this friendly, if not "filial," relationship possible. On the side of tributary relationship, Wang (2012) pointed out that, "China as the center of the world and the peripheries of other countries [were] defined in terms of the son of heaven's obligations to pay greater gifts to the tribal chieftains, who were, in turn, the 'sons' of their emperor 'father." This suggests that albeit China was located at the center of T'ien and/or ruler of the cosmos, it did not claim full or entire control of the system, hence, societies located at the fringe (i.e. barangay) were free to manage their own affairs (Ringmar, 2012). Kinship, on the other hand, completed this tie with trust.

The Birth of the Nation-State

The concept of the state is considerably a new invention, commencing at least two centuries past. There is no doubt that the birth of the state reconfigured the once mutual relationship between China and the Philippines essentially because of the pressure of fulfilling the requirements necessary for the maintenance of statehood. In the study conducted by Sass Rogando Sassot (2017), the conflict between these countries at the dawn of the twentieth century occurred due these factors: the rise of cartographic state, sovereignty as the right to exclude, and the territorialization of the sea.

Jean-Paul Sartre's Approaches to Freedom

Sartre acknowledge the importance of "human essence." Man is enmeshed in history and have an essence. Man, taking part in history freely projects himself toward future possibilities. Thus, man's essence is simply a residue, a result, a solidification of the eminently free and fluid temporalizing spontaneity that he is. In short, human reality is not an entity but a process.

When man chooses freedom as his absolute, he chooses himself absolutely because he is himself freedom. But, exactly as freedom, he is ambiguous being that "is what it is not and is not what it is." To choose himself as freedom, therefore, is to assume ambiguity. It is not merely to accept but to maintain and will both the "is" and "is not" that defines him. What this commitment means can be summarized in the terms "engagement" and "transcendence."

Jean-Paul Sartre's analysis invites us to closely examine the continued, uninterrupted flow of experience and interaction between Chinese and Philippine societies/polities. Prior to the birth of the nation-state mutual relations between these societies could be observed. In the context of maritime activity, it is worth to recall that in its precolonial times, people freely exchanged goods, traveled in a sea which stood as a bridge and gateway to both societies, and shared the resources within it.

However, the birth of the state paved the way for both countries to define the boarders and the extent of their territories. Some nations with the unfortunate inability to morph into statehood had lost their lands and domains and eventually divided and assimilated into several states as experienced by Kurdistan and Palestine.

Another example whereby the shift to statehood affects the way people interact with regard to their territory is found in the experience of the indigenous peoples whose legitimacy over their domains is dependent on the communal land title from the State. A general concession as far as indigenous voices are concerned is the idea that land (territory) is deeply attached to their identity. Regulating their land, therefore, is fatal to their overall practice of customs and governance structures.

The above examples demonstrate that both in the internal and external levels, states struggle to maintain sovereignty. To territorialize is one of the concrete means and exercise of sovereignty. However, in the context of this study, one of the offshoots of this territorialization are the divide and staining of the historic ties in the name of perpetuating this supreme political entity – the state.

Gabriel Marcel's Approaches to Freedom

Marcel regards freedom as peculiar to certain acts of a definite sort rather than as coextensive with conscious process generally. He maintains that freedom is rooted in the superabundance peculiar to spiritual being rather than in the void; "fulfilment" succeeds "value." He recognizes freedom as desirable only to the extent that it serves the achievement of the free person.

Marcel elaborates a basic notion of intersubjectivity. The meaning of intersubjectivity concerns the relation of communion among or between independently subsisting subjects. To be free is both to recognize and to engage creatively the profound self of being in preference to, or in despite of, other superficial self-modalities. True understanding of his own intersubjective structure is approached by a self only indirectly, that is, through communion with a "thou" who loves him at the profound level of his self-being and who thereby discovers to him his subjectivity in its uniqueness and depth.

Reduced to its simplest terms, intersubjectivity is largely based on individuals' personal encounters across spaces. Other terms that could describe this concept is mutual coexistence and interaction. In the pre-colonial times, intersubjectivity can be demonstrated by tributary relationships and kinship networks between these two polities since both acts requires certain level of trust. Currently, despite the conflictual relationships brought about by territorialization, attempts for bilateral partnership may forge and redefine a certain level of intersubjectivity between these two states.

Critical Evaluation and Conclusions

The analyses of Sartre and Marcel oppose each other: To Sartre the very existence of a self seems a major threat to freedom; to Marcel the fulfilment of the self is precisely the main purpose of freedom. For Sartre being and value exist in rigorous dependence upon freedom; for Marcel freedom exist in rigorous dependence upon being and value. In Sartre's view the existence of an absolute Being means the death of human freedom; in Marcel's view, human freedom is unintelligible apart from such a being. Doubtless one fundamental opposition underlies all others: For Sartre freedom is negation, for Marcel freedom is affirmation.

Variances as deep as these are more significant when it is considered that Sartre and Marcel concur on a common method, particularly, the phenomenological method. Both set out to describe the human experience of freedom as it appears to consciousness. Each claim to uncover the ontological meaning of the freedom-experience through discovery of its basic structure.

At the end, this paper suggests that both countries need to go back and rekindle their original experience. There are for sure hard and vast hurdles in the discourse of who truly and rightfully owns the contested territory given pieces of evidences were presented from both sides. The point on the territory, hence, represents Sartrean freedom, the negative one.

However, there are so much things can be explored by focusing on the discourse of intersubjectivity. Here, both countries could look back that their relations was once under the climate of mutual trust and somehow sharing instead of dividing the space.

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