An International Peer Reviewed Faculty Research Journal
of the University of the Immaculate Conception

UIC Research Journal

INTERNATIONAL EDITION

Volume 21 Number 1 April 2015 Print ISSN 1656-0604 Online ISSN 2244-6532

Multidisciplinary International

CHED - JAS accredited

From Grassroots to Internationalization: Filling in the Gap through Research

crossref Google scholar PEJ DOAJ DIRECTORY OF OPEN ACCES JOURNALS

ISSN 1656-0604 / Online ISSN 2244-6532

The UIC RESEARCH JOURNAL 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.

The reports published in this journal go through a meticulous double-blind refereeing process to assure the academic quality. The editors, research committee members, and the reviewers are renowned critics and scholars in various fields covered in the journal.

Publisher
University of the Immaculate Conception
Bonifacio St., 8000, Davao City
Philippines
Telefax (63) (82) 227-37-94
Website: http://uic.edu.ph

UIC RESEARCH JOURNAL
International Edition
Volume 21, Number 1, April 2015

UIC RESEARCH JOURNAL POLICY

Editorial Policy

The UIC RESEARCH JOURNAL 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.

The UIC RESEARCH JOURNAL is open to the global community of scholars. Being a member of prestigious international research organizations, the journal requires its contributors to have each an open researcher and contributor's ID which warrants inclusion of the research in the ORCID database and also shows a contributors track record of publications in the ORCID database.

Articles submitted for review with the UIC Research Journal go through a double- blind review process to assure academic quality. The efficiency and effectiveness of the editorial review process are critically dependent upon the actions of both the research authors and the reviewers. An author accepts the responsibility preparing the research for evaluation by independent reviewers. The responsibility includes subjecting the manuscript to evaluation by peers and revising prior to submission. The review process is not used as a means of obtaining feedback at early stages of developing the research paper. The editors, research committee members and reviewers hail from a variety of fields and disciplines and have established track records in research. Aside from notable Filipino researchers, the journal has enlisted the expertise of scholars from the United States, the United Kingdom, Indonesia and Australia on its roster of international reviewers.

Retraction Policy

The UIC RESEARCH JOURNAL reserves the right of retraction over all submitted, accepted, and/or published articles in the event that an article is found to have fraudulent claims/ findings or contain serious errors in methodology or contain plagiarism in any form. Retraction refers to the publisher's act of removing an article from the digital file due to post publication defects which escaped detection in the quality assurance process. The retraction of an article however,

is still subject to due process as the writer/ contributor of the article is informed that a complaint has been received or a detection of post publication defect has been made by the UIC Research and Publication office. Proper investigation and validation is made by the publisher before ultimately retracting an article.

Policy on Digital Preservation

The UIC RESEARCH JOURNAL digitally preserves files for purposes of archiving all materials in the publication process in order to ensure continued access of students, faculty and subscribers to the information provided by the journal. Digital preservation is the process of storing systematically electronic files in multiple formats such as compact discs, cloud computing, Google Drive, email accounts, external hard drives, among others. This is done to ensure that in the event of website crashes, file corruption, infection of computer virus or whether by natural calamity, fire or any kind of destruction to a file, there are still retrievable copies of the information.

Policy on Handling Complaints

In case of any complaint about the journal or any article therein such as breach of copyright and other intellectual property rights, inaccuracies of information, derogatory materials or statements, the UIC Editorial Board will render investigation on the complaint. This may prompt calling the attention of the parties involved to clarify their claims. The UIC Editorial Board will then decide whether the article in question should stay or be removed depending on the gravity of the allegation and the evidence presented by both parties.

Consequently, the board would ask the author(s) of the article to sign a retraction to pull out the article from the journal to avoid other legal problems to arise out of the mistake.

Policy on Use of Human/ Animal Subjects in Research

The UIC Editorial Board will only accept articles involving human participants or animal subjects in their research if the author(s) has/have complied with ethical protocols mandated by the appropriate institutional ethics review board.

Policy on Conflicts of Interest

The UIC Research Journal reserves the right to protect its interest as regards the fair authority and ownership of its published researches. The journal will only publish articles after the author(s), researchers and contributors have ensured compliance to specific requirements needed by the Editorial Board. If there are other potential conflicts of interest that must be addressed, the said author(s), researchers and contributors must appropriately submit a conflict of interest disclosure.

Publication Ethics and Publication Malpractice

The UIC Research Journal is academically devoted to maintain the noblest ethical publication standards and to eradicate malpractices in research publication. Researcher(s) submitting their articles to the UIC Research Journal for publication as original articles confirm that the work embody their author's contribution and are not copied. Disclosure of any possible conflict of interest with the authors' work or profits associated with it should be acknowledged by the authors. The UIC Research Journal's commitment to unbiased and fair double-blind peer review of the author's submitted manuscript for publication is done to avoid any possible conflicts of interest between the editorial and review personnel and the reviewed material. In the event that violations from any of the abovementioned guidelines, the chief editors should be informed.

Both the reviewers and editors are anonymous to one another. This is observed to avoid biases in the process of reviewing the submitted scholarly papers.

Peer Review System

Definition. Peer review is a systematic process of evaluating and assessing the quality of the submitted research articles before they are deemed fit for publication. This is done to ensure whether results of the study should be published in a scientific journal. An author's study is subject for scrutiny by qualified people who have similar expertise within the relevant field. In academic publication, peer review is used to officially decide a study's qualification for publication. The employment of peer review methods maintains standards of quality, improves performance, and provides credibility.

Type. Double-blind peer review is the type of assessment or evaluation in which the author(s) and the reviewer(s) do not know each other's identities, both having the same field of specialization. This is done to ensure that the submitted article is examined by a qualified evaluator.

Recruiting Referees. It is the Editorial Board's responsibility to select peer reviewers. After an author sends the scholarly research article, an editor looks for reviewers who have the same field of specialization. Utmost care is considered in the selection of peer reviewers who have published articles in reputable journals as evidence of research and publication track record. Through this, the publishable article is ensured to be in its finest quality.

Peer Review Process. The Editorial Board sends manuscript of the article to undergo a double-blind peer review process to reviewers who are experts in the field. The manuscripts are accompanied with rating sheets for both quantitative and qualitative evaluation. There are at least two referees to review an article, at least one local reviewer and at least one international reviewer. These reviewers are experts in the discipline and know the technical aspects of the research articles to ensure the quality of the paper to be published.

The identity of the peer reviewers and the author/s are both confidential to avoid biases and conflicts from both parties. The reviewers will return the manuscripts to the board along with the rating sheets with their evaluations and suggestions on how to improve the papers. The authors will then be notified to revise their papers based on the referees' comments as approved by the board. The board will then deliberate the merit of the revised paper as to its publishability.

Criteria for Acceptance and Rejection. A manuscript is considered accepted when it is (1) endorsed for publication by the peer reviewers; (2) instruction/s of the peer reviewers are complied by the authors; (3) ethical standards and protocols are followed concerning human involvement or handling of animals in the study; (4) the manuscript has passed all the required Technology-Based Quality Assurance (TBQA) tests required by the Research and Publication Center; otherwise, the editorial board will deem the manuscript rejected. The referees' assessment of the manuscript includes objective recommendation of what to do with the manuscript based from the options provided by the journal as incorporated in the evaluation sheet. The following are the recommendations that may be given by the referees:

- The paper is recommended for publication as written.
- 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.

Comments. The UIC Research Journal: International Edition welcomes submission of comments on previous articles published. This comments shall be reviewed by two external reviewers, among them might be the original author of the paper (to assist the editor in evaluating the comments) and an independent reviewer.

Technology – based Quality Assurance (TBQA)

Plagiarism Detection. The Research and Publication Center owns updated software for plagiarism. Each submitted manuscript will undergo plagiarism check. The standard set is 95 percent original to pass the said test and will eventually increase its chances of acceptance.

Appropriateness of Citation Format. The contributors are advised to use the citation format prescribed by the Council of Science Editors.

Word Count, Spelling and Grammar Checks. Contributors are encouraged to perform word count for the abstract (200) and the full text (about 4000 or more). Spelling and grammar checks should be performed prior to submission. The standard set is 90 percent to pass the Grammarly Software.

ORCID Membership of Authors. The UIC Research Journal requires contributors to submit an ORCID number as proof of membership from orcid. org or open researcher contributor ID.

INSTRUCTIONS FOR AUTHORS

General Information

UIC Research Journal is a peer-reviewed inter-and multi-disciplinary journal. It is a bi-annual publication intended for the faculty and graduate student researches which tackles significant issues and contributes important findings 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.

Preparation and Submission

Manuscript/s to be submitted to the Editorial Board of UIC Research Journal 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.

Following the format and the order of presentation, the article should be no more than 5000 words or 20 pages, inclusive of photos, graphs, tables and illustrations.

Documentation

Citations: The UIC Research Journal: International Edition 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.

Literature Cited

Reference quality and accuracy have been a known issue in journal publishing for many years. In an age of evolving publishing models, participants in the scholarly communications process are paying more attention than ever to measurable results. At the forefront of this emphasis on quantification are statistics that rely on accurate references and reference linking. Thus, every manuscript must include a "Literature Cited" section that contains only those

works cited within the text.

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.

Submission of the Manuscript

In the event of submitting a manuscript for publication, the author should take note of the following considerations:

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

Conceptualized to represent this issue's theme, the cover symbolizes the dynamics in the pursuit of internationalization. The long and complex process is made possible with the help of research outputs, which is depicted by the heavy traffic of papers and manuscripts to and fro the globe as emblem of truly international institutions. To be more beneficial, every institution's internationalization mission should collectively involve all its leadership and member units, represented in the cover by the human figures.

Mary Jane G. Barluado
Associate Editor

About the Monogram

The UIC Research Journal International Edition 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 UIC Research Journal International Edition.

Renan P. Limjuco
Editor in Chief

CONTENTS

Perspective

Original Articles

Health and Technology

Science and Mathematics Education

PREFACE

Higher education institutions (HEI) recognized to have reached global status can take pride having strong grassroots. They are known for their research as the enthroning agent of their internationalization, a process that requires HEIs to integrate intercultural and global dimensions into their operations and goals, and wherein research are essentially obligatory.

This issue of the UIC Research Journal International Edition expands to have a *Perspective* section to highlight the article on internationalization of the University of the Immaculate Conception (UIC) authored by the institution's visionary president, S. Maria Marissa Viri, RVM together with some UIC researchers. Pivotal to this is the ASEAN 2015 integration taken by responsive HEIs including UIC, as advantageous and timely for internationalization. Hence, against the backdrop of the internal situation and prevailing national and international educational status quo, the article bravely presents the institution's aspects needing review, offers frameworks as basis for internationalization, discusses dimensions of development and challenges, and provides implications for research.

The original articles are categorized into three sections, each featuring three erudite exploits by researchers from all over the Philippines. In the first section, *Health and Technology*, Dr. Crislee Torio and Dr. Lilian De la Merced foreground a widely distributed but overlooked kulitis *(A. spinosus)* plant as an excellent source of dietary and medicinal antioxidants, as well as flavonoid preservative for foodstuff and pharmaceuticals. Another article authored by Dr. Alwielland Bello features the development of a functional resonance tube setup with sound generated from a laptop. Of translational importance was the article that highlights the collaborative efforts of UIC Health, Engineering, and Research faculty in developing a low-cost device that measures blood alcohol concentration in a person's breath. This particular study led by Dr. Renan Limjuco is a response of UIC to the Philippine Republic Act No. 10586, a.k.a. "Anti-Drunk and Drugged Driving Act" which stipulates on the spot breath testing among drivers suspected to be under alcohol influence, using alcohol breath analyzers, of which the law enforcement agencies (Land Transportation Office and the Philippine National Police) do not have enough up to now.

In the second section, *Science and Mathematics Education*, Dr. Rochelle Papasin presents an enlightening dimension why some Philippine Science High School (PSHS) scholars, who were expected and molded to be the country's future scientists, end up taking non-STEM higher education courses, thus implicating the PSHS need to revisit its purpose in the development of science and technology capability of the Filipino nation. The section also features the scholarly work of Dr. Edna Salva on pedagogic use of two-tier diagnostic instrument in General Inorganic Chemistry. Finally, the cogently seasoned article of Dr. Sylvia Pidor escorts the readers in re-visiting all 13 Southern Mindanao RVM high schools, showing their Science and Math teachers' profile vis-a-vis their students' achievements, with results that now lead to the schools' current accreditation status.

In the third section, *Psychology and Theology*, two articles tackle the complex human prosocial behavior as a possible outgrowth of practice of religion by Prof. Jame Bryan Batara, and as integral to Christian moral values by Dr. Vicky Bantillo. Finally and of equal relevance, the article of Dr. Mona Laya and Prof. Veronica Cruzada elucidates the relationships of emotional competence, academic performance and work-related variables to work ethics in a sample population of working students.

Whether grassroots research or endeavoring for internationalization, the articles in this issue together provide the multidisciplinary feel of the UIC Research Journal International Edition.

Mary Jane G. Barluado
Associate Editor

UIC Research Journal
Vol. 21 No. 1 April 2015

Print ISSN 1656-0604
Online ISSN 2244-6532

Perspective

*i*UIC: Reaching Out Globally via Internationalization

S. Maria Marissa R. Viri, RVM[1], Renan P. Limjuco,
Mary Jane G. Barluado, Jo-Ann Y. Solomon, Ma. Juliet G. Vasay,
John Rey A. Aleria, and Kristine May M. Adlaon
University of the Immaculate Conception
Davao City, Philippines

[1]Corresponding author's email address: presoffice1@uic.edu.ph

More than underscoring the intention of the University of the Immaculate Conception (UIC) to internationalize in response to the ASEAN Integration 2015, this article provides a preview of an international UIC (iUIC) as a competitive academe of the ASEAN Economic Community (AEC).

BACKGROUND and ASSUMPTIONS

Awareness of AEC. There have been extensive efforts among ASEAN member nations to establish a well-organized network to ascertain not only peace and security (ASEAN Political-Security Community, 2010) and economic stability (ASEAN Economic Community, 2010) but also educational strategies (ASEAN Universities Network, 2007) of the Asian region in the midst of very dynamic global competition with other countries outside the ASEAN region. Along with this vision is the consideration of cultural differences (ASEAN Socio-Cultural Community, 2010) of various races that need to be looked into to achieve harmonious flow of relationships especially economic. Indeed, the establishment of ASEAN community has brought dramatic and very significant results to its members that undoubtedly spell progress. In the early implementation of these programs since 2009, statistical data have shown that the average actual number of years of schooling by adults has increased, adult and youth literacy rates have remarkably improved and equity in access to education has been established, to name a few.

Development of AEC Human Resources. To assure sustainability of the development of human resources, and empowerment in science and technology of all workers in the ASEAN community, the education systems of countries in the region must confront many challenges. Thus, it is imperative to promote life-long learning, and closer and greater educational cooperation among ASEAN member nations. Things to focus on include a) development of national skills framework consistent with ASEAN skills; b) promotion of greater student mobility; c) support for greater mobility of skilled workers; d) development of ASEAN competency-based occupational standard; and e) development of a common standard of competencies.

K to 12 of the Department of Education (DepEd). In the Philippines, there is a dramatic change of basic education curriculum through the implementation of the K to 12 program by DepEd. This paradigm is designed to facilitate the offering of academic programs that can equip the country's senior high school graduates with necessary skills to compete abroad for job placements and other career opportunities. The demand for competitive skills in global scenario has created strain in educational policies of the country, necessitating the overdue redirection of basic education curriculum towards producing graduates who are prepared to be productive citizens of the 21st century.

Outcomes-based Education (OBE) and Quality Assurance of the Commission on Higher Education (CHED). These new educational reforms continuously put every higher education institution (HEI) to test. Simply, CHED describes OBE as the establishment of what the student is expected to do at the end of the course and a commitment to ensuring that every student achieves at least the minimum proficiencies before being allowed to graduate. The challenge therefore of every HEI is to restructure its curriculum to reflect the achievement of higher order learning and mastery rather than just accumulation of course credits. On the other hand, CHED defines Quality Assurance as the alignment and consistency of the learning environment with the vision, mission and goals demonstrated by excellent service and outcomes and the development of culture of quality. It is also about ensuring the processes and procedures and systems of operation are in place.

UIC State of Affairs. Updated facilities, equipment and laboratories, good training and discipline are a few of the many aspects that enable UIC to stand amidst challenges in the external environment. As owned and managed by the

Religious of the Virgin Mary (RVM) Congregation, on its foundation is the Ignacian Marian Education. Added to these are the strong faculty profile and the evidence of good relationship that provides the school support in their quest for service and excellence. The RVM Quality Road Map serves as a guide of the University in its endeavor to maintain, sustain and continually improve the school's quality assurance system and achieve goals and objectives. The said map embraces the standards and framework of the Philippine Accrediting Association of Schools, Colleges, and Universities (PAASCU) in its evaluation and internal audit. True to its mission therefore of offering quality and excellent education, UIC endeavored several initiatives and strategies to cope up and respond to the challenges in its environment. It conducted evaluations, surveys and interviews to determine what were being done and what were expected and whether the school is moving towards the desired direction. After series of evaluations and surveys, it was found that the school has to work on the improvement of the following areas: systems, processes and procedures, review and revisit of the curriculum and instruction, faculty development, and research (despite of the significant progress in research performance evaluation of the university as evidenced by awards and recognitions in international research conferences and international journal publications) particularly on the needs of the communities and organization.

UIC's Response to ASEAN Integration 2015 and Globalization. Internationalization is one of the ways UIC responds to the impacts of globalization. The impacts of globalization, technological advancement, and trade investment liberalization under the General Agreement on Trade in Services (GATS) adopted in 1994 by then established World Trade Organization (WTO) have prompted the Philippines to play a more active role regionally and internationally. The goal of producing quality human resources who could function well in the knowledge-based society redirects CHED to respond to this global challenge. UIC aims to be recognized as international leader in the global higher education and research. In its moving forward, UIC identifies strategic priorities for the next 3-5 years, and strongly believes that it's necessary to identify its goals and priorities in relation to global education and internationalization. This would heighten the quality of teaching and learning through international outlook and academic cooperation with higher education institutions and education organizations both regionally and internationally.

It is for this reason that an institutional model to fully envision a cohesive scheme of resources, plans, systems, and procedures is formulated to develop

its potential while at the same time meeting the current demands of the UIC community. Frameworks are proposed to ultimately lead to one constructive plan to actively internationalize the university.

FRAMEWORKS

1. Institutional Development Challenges Framework. For years, UIC has established a reputation of providing an RVM culture of education and recognition. With the different programs aligned to target its aims for answering the needs and challenges imposed by the present times, its different programs namely Accountancy and Business Administration, Education, Information Technology Education, Pharmacy and Chemistry, Music, Medical Laboratory Science, Engineering and Architecture, Nursing, Liberal Arts, and Nutrition and Dietetics - Hotel and Restaurant Management - Tourism, promote a competitive and globally-oriented set of courses and trainings.

With the onset of ASEAN 2015, what challenges does the RVM education community face? As McCarthy (2014) pointed out, internationalization as an offshoot of the ASEAN integration will require education systems of the region to invest more seriously in citizenship education, including teaching and learning in a multi-cultural society; language and socio-cultural issues and common approach to guide regional education initiatives. The UIC Development Challenges Framework is represented by two objects: a secured symbolic square and a group of abrasive arrows. The square signifies the effective employment of the institution's Vision, Mission and Goal coupled with its various achievements and commitments to its stakeholders and the society. The UIC academic programs continue to bring a stimulated flow of information and excellence anchored by the desire to establish an RVM stronger education system. The arrows promote the many external pressing concerns of the current times, prevailing issues of poverty, equity and human development, straining consumerism and lifestyle changes, economic instability, among others. These are the same, revolving problems that do not vanish but replicates itself every time, and pose challenges to our institutional development (figure 1).

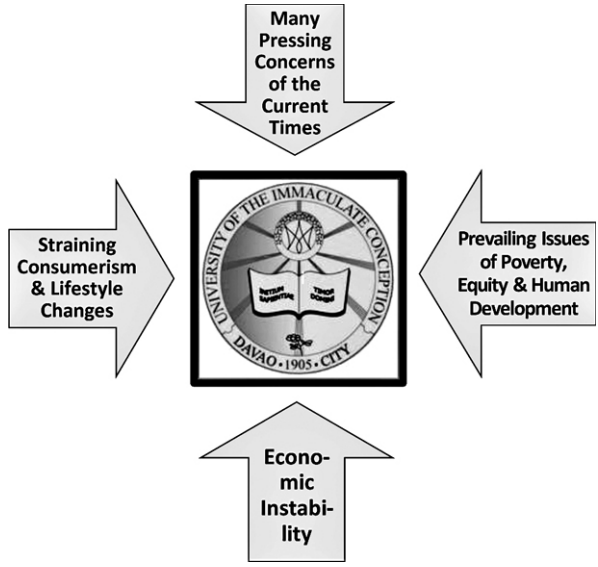

Figure 1. Institutional development challenges framework

Hence, to achieve an ensuring excellence and transformation, we take on an internationalization framework as a roadmap to achieving our principal goals and focused courses.

2. UIC Roadmap to Internationalization Framework. The UIC internationalization framework is founded on the intention of the UIC community to build a new course as we target faith and excellence in our service (core values of RVM) and to re-align our aims accordingly. "To contribute in the spirit of regional unity and excellence," the UIC from a successful structured RVM core, through five identified key directions, will elevate to having a broad system of skills. Aiming to strengthen the RVM brand of excellence and influence, these key directions embed the institution's Vision, Mission, Goal, and Objectives, and are meant to be suggestive, not prescriptive on our open efforts to effect internationalization. By a cyclical process that is not necessarily sequenced, and which may overlap in strategies that are expected to steer UIC into an international institution, we dub these five key directions as *i*INNOVATE, *i*COMMUNICATE, *i*INITIATE, *i*COLLABORATE, and *i*EMERGE (figure 2).

Figure 2. UIC internationalization framework

iINNOVATE. This stance represents the efforts of UIC to re-invent, restructure and modify itself as an academic institution to prepare for the influx of foreign students. The admission of new set of learners with entirely different culture should compel the University to transform its school climate and culture in general. One strategy UIC can adopt is to align or make flexible its academic programs with those of leading HEIs in the ASEAN region, and ensure production of graduates with strong sense of innovativeness needed by the global economic community.

iCOMMUNICATE. UIC must disseminate its intention to address the demands of globalization specifically that of ASEAN Integration 2015, thus the need to adopt an open stance policy to welcome and embrace mutually beneficial planning and brainstorming sessions to inform various stakeholders of the status of the university and its capability to internationalize.

iINITIATE. UIC must not be afraid to act as a pioneer in establishing projects and partnerships to facilitate the mobility of both faculty and students from other countries to aid in training, curriculum planning and industry immersion, to cite a few. To the effect of enriching and increasing linkage initiatives with industries, UIC must act on the findings of tracer assessments on the quality and competence of its graduates.

***i*COLLABORATE.** Linkages must be one of the primary considerations for UIC internationalization. The university must provide an atmosphere of accessibility for other international schools, organizations, and agencies to forge partnerships especially in research and other creative projects.

***i*EMERGE.** UIC must actualize the blueprint to being an international academic institution and must sustain the development of its vision, mission, goals, and objectives as reflected in the academic programs through research, extension, curricular plans, and advocacy efforts that promote borderless international educational environment.

3. *i*UIC Stakeholder Framework. To be international is to be felt by international players in the industry. In consideration of the internationalization plans of UIC, having a totally different institutional landscape characterized by a rich group of stakeholders can be envisioned. The *i*UIC Stakeholder Framework sneaks into these questions: a) What typology of faculty and staff does *i*UIC have? b) How are *i*UIC research and publications in terms of contribution of new knowledge and being cited faring in the region? c) What organizational System View is in operation among *i*UIC leaderships in their development strategies? The answers must take in consideration the country's educational status quo, summarized as follows: a) Poor performance compared to other ASEAN countries in terms of ASEAN 2015 integration; b) CHED recognizes that the private sector stirs higher education in the country. Among ASEAN nations, the top 3 universities are always public universities, except in the Philippines where two of the top three universities are private HEIs; c) The government does not fund education institutions, public or private, as fully or as much as in other countries.

At this point, UIC transformation to *i*UIC seems to be a gargantuan task, and demands an open-minded reflection of what organizational system view to be in operation in *i*UIC. The Open System organizational perspective focuses on events occurring external to the organization and influence changes within the organization, and wherein workers are recognized as members of social groups, which play important roles in shaping their behaviors and actions (Daft, 2001). As an open-system institution, *i*UIC would embed the four basic characteristics of human relations theory: individual differences, motivation, mutual interest and human dignity. These would define the interconnectedness of *i*UIC to different groups outside it as well as the groups' interconnectedness with each other, in the design of its developmental strategies. In *i*UIC, the different sectors comprising

the stakeholders are expected to be more heterogeneous than homogeneous. Students and faculty are expected to be multicultural; partnerships and linkages are anticipated to be not just with local but with international governments and industries, and their success depends on the recognition that the different sectors of stakeholders do not just interconnect with *i*UIC but also themselves interconnect with each other, maybe more so. Hence, the name of the game is collaboration – not just bilateral but also multi-lateral or crossways (figure 3).

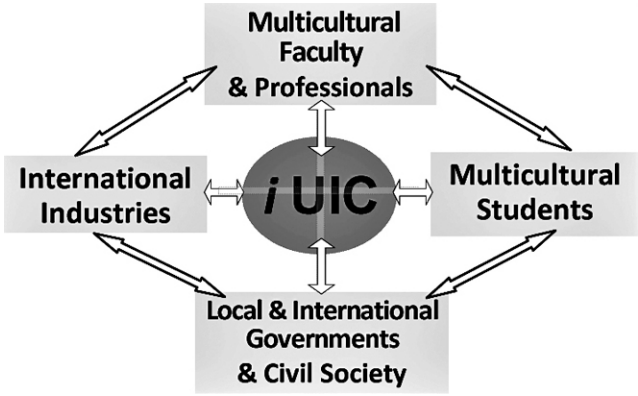

Figure 3. *i*UIC stakeholder map by open system perspective

_i_UIC Stakeholders

Multicultural Faculty and Professionals. From the outset, *i*UIC would have to liberalize its recruitment strategy to bring in a winning richness of perspectives that is only possible by having diversified faculty and professionals. Hence, *i*UIC needs international or foreign-trained academics, as well as to send faculty for studies and fellowships abroad. The diversified cultural background and internationally recognized qualifications of the *i*UIC academic community would beef up its capabilities to be able to efficiently represent itself in and fully benefit from the interconnections. Importantly, *i*UIC vast research and teaching experience are necessary for the multicultural students to openly learn from them. Also, through collaborations with fellows from leading foreign universities, *i*UIC faculty can learn from their best practices while also promoting the institutions' unique RVM branding and strengths.

Multicultural Students. *i*UIC is expected to compete with major global universities known to have serviced export students. *i*UIC would expand bilateral arrangements with foreign universities for student exchange and mobility programs. To cater to more international students, it would have internationalized academic programs such as joint or twinning degrees with partner foreign institutions. As a support structure, under the auspices of the student affairs, *i*UIC would put up an international office that would help assist international students in matters including legal, housing, settling in, culture and language, as well as organizing a strong and friendly International Students Organization. Additionally, apart from the regular undergraduate international students, *i*UIC would have foreign students in its graduate programs, enriching its research activities and innovations.

International Industries. For *i*UIC to be an active and competitive ASEAN university, it must gear towards partnering with the different sectors of industries including but not limited to the academic, labor, health, information sectors. The key to do this is quality assurance. *i*UIC would have in place both internal and external quality management systems that meet international standards not only in its administrative operations but also in its academic programs. Having these quality management systems certified and recognized by international quality assessors is essential as it would validate quality services (programs etc.) and products (graduates) of *i*UIC. Specifically in the education industry, *i*UIC would pursue membership with international organizations like Asian University Network (AUN) and Washington Accord, in its quest for quality.

Local and International Governments and Civil Society. *i*UIC will take into account the roles of local and international governments and the civil society in its international expansions. With foreseeable resistance from politically-motivated groups, there is a chance that after sometime, government agencies may be caught in the same traditional things. *i*UIC must participate in efforts of the local and national governments to achieve a politically and socially secure place, lead by a stable government with laws for the safety of multicultural community, to make it ideal for studying and living. It must aim becoming free from racial and religious mishaps. Furthermore, targeting to increase student mobility, *i*UIC would be conscious of changes, happenings, and laws in both national and international governments, and be proactive in taking initiatives for collaborations, which are also necessary to multiply academic and research partnerships.

*i*UIC DIMENSIONS OF DEVELOPMENT

The model emphasizes 14 dimensions of development namely:

1. Promotion of RVM Brand of Excellence
2. National Government Quality Standards of Education
3. International Standard of Curriculum Structure (OBE/AUN)
4. Instructional Materials Development
5. ICT Development
6. Cross-Cultural Adaptation Program
7. International Quality Assurance
8. Twinning Program
9. Mobility of Student/Faculty
10. International Scholarships for Faculty and Students
11. International Training Programs for Human Resource
12. Research Collaboration
13. Partnership and Linkages
14. Social Orientation and Community Involvement

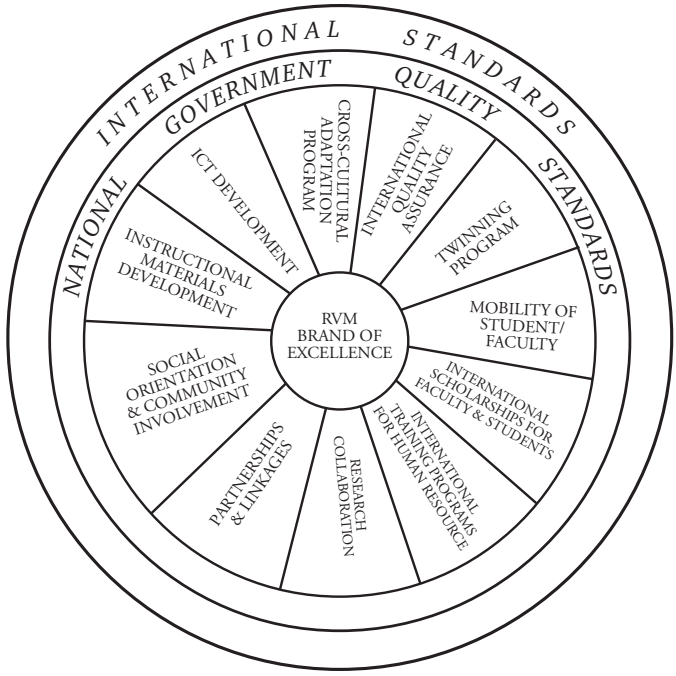

Figure 4. Framework for dimensions of development for *i*UIC

Figure 4 shows the interrelationships among the fourteen dimensions of development towards the transformation of UIC to the *i*UIC structure. The outermost circle represents the international standards which influence the national government quality standards as outlined in the next concentric circle. The innermost circle represents the core of the *i*UIC which is the RVM brand of excellence. The remaining circle which is divided into sectors reveals the other eleven institutional dimensions namely, instructional materials development, ICT development, cross-cultural adaptation program, etc. which all anchored to the core and surrounded by the external factors such as the internal and national standards of quality pertaining to the ASEAN integration 2015 paradigm as well as to the globalization movement.

1. Promotion of RVM Brand of Excellence. UIC, being a Catholic university that envisions the transformation of society in response to the signs of the times must be prepared to experience "an evolution" of its educational policies as its major aim in the next years is to promote the RVM brand of excellence not only to Asian region but globally as well. As an academic institution, UIC must infuse faith and culture to be understood as the meeting of divinity (infinite and absolute in all forms of existence) and humanity (diverse culture) through religions. Thus, UIC must specify the curriculum that must still promote respect for life and creation and the need to build a common human community amidst the multiplicity of Asian learners.

There must be a determined effort to put UIC in the international map of academic excellence. The University needs to continue adhering to its "branding,"e.g. an international version of the College signposts IGNITES, a defining characteristic which makes the parents entrust the education of their children to this RVM-run academia. Exemplifying the virtues of Mother Ignacia del Espiritu Santo through its RVM education, the UIC as a domain of Christian ideals plays a crucial role in the midst of today's generation. More than ever, this is the time when UIC has to become more vigilant in advancing its intention – to commit to provide quality Ignacian Marian education to prepare international students as agents of transformation to achieve a better global community amidst differences in culture and religion and to produce leaders who witness to faith, excellence and service, grow in discernment and interior freedom, promote culture of appreciation, support, and harmony with God's creation, strengthen our Filipino culture, and respect and understand all Christian, Muslims and Lumads. With this, UIC students and graduates would be agents to promote the

institution's unique spirit, as they apply distinctly Marian-Filipino-international perspective in their creativity and innovations that can be bannered globally as UIC's contribution to human progress.

2. National Government Quality Standards of Education. The University must be quick to respond to the imperatives or suggestions of national government agencies, e.g. CHED, DepEd and TESDA in line with the seamless and smooth transition of its academic policies specifically, the curriculum, research, linkages and on the job training and practicum orientations, towards the fast integration of ASEAN nations' international practices into these curricular programs. UIC must be conscious of its institutional development plan incorporating into it academic structures to facilitate the implementation of K to 12, OBE and the consideration of ASEAN frameworks of mutual recognition arrangement on specific curricular offerings. The assurance of producing quality graduates who can compete globally, in terms of knowledge and skills must be given focus as UIC becomes more critical of its graduates and their performances in national licensure examinations, and in other international tests that measure competence assessments to gauge equivalency.

3. International Standard of Curriculum Structure. The University implements a curriculum that demonstrates international knowledge and skills as part of its degree requirements. All academic departments will incorporate higher level of activity than the usual practice. It will encourage the development of a common standard of competencies for both basic and tertiary educations as a base for benchmarking with a view to promote mutual recognition (Seoul Accord, Washington Accord, Bologna Accord etc). The University may also look for faculty with international expertise and supports the ongoing development of this expertise by resident faculty. This would help increase scholarly research and international publications. It is also expected that UIC regularly updates the syllabus of course offerings to integrate the new trends and address pressing issues around the globe that have implications to education.

4. Instructional Materials Development. UIC supports the creation and substantial revision of comprehensive curricula and supplemental instructional materials that are research-based; enhance classroom instruction e.g. K-12 framework; and reflect standards for science, mathematics, and technology education developed by national and international professional organizations. The University must organize a dynamic Instructional Materials Committee that can critically determine the soundness of the developed learning manuals

that must be both research- and technology-based. UIC must partner with technology-based agencies to achieve such aim. On top of this, UIC must regularly conduct workshops on construction and designing of learning materials to assure the involvement of competent faculty members who must be innovative, research and service-oriented, instructional materials developers and committed to international/multicultural student professional development.

5. ICT Development. The University should think of maximizing the utilization of its resources and offer up-to-date technological resources to enhance student learning (Online curriculum, eLearning, Blended Learning, Digital Libraries, etc.) and faculty capability to adopt Web 2.0 technologies (Social Networking, Blog, Wikis, CMS) in teaching-learning process. The university has classrooms equipped with the state of the art technologies. The University has to implement curricular enhancement in the form of virtual learning environment. Finally, UIC should develop an ICT network that will improve the infrastructure support for innovations in research and pedagogy.

6. Cross - Cultural Adaptation Program. To prepare for the influx of foreign students and visiting professors and consultants, UIC must provide a structure that can address needs of these groups in terms of culture differences specifically in traits, practices, and languages to minimize culture shock. The university must set up a kind of student/ faculty assistance hotline for overseas transactions from and into its important offices. There must be a short-term yet intensive bridging program (or settling in program) for incoming international students that will immerse them to Filipino culture and language prior to formally starting their studies in UIC. There must be an international student advisory service to readily assist foreign students and direct them to specific facility as regards their concerns being a "fresh" intercultural learner or visiting scholar.

Further, as UIC grows into having a metropolitan population of students from diverse backgrounds, it must put up several Support Service Groups that will readily cater to the unique needs of these groups of students for them to get the most of their learning experience in UIC. These support groups may include:

Parent/ Family Students Support Group
Indigenous Students Support Group
LGBT Support Group
Mature-Age Students Support Group
Working/ Parttimers Support Group
Online Support System

7. International Quality Assurance. UIC will set up a quality control mechanism to ensure minimum standards of degree of International Programs at all levels (undergraduate and graduate diploma). It is expected that it must be strictly conducted and monitored not only by the University through the Internal Quality Assurance unit for quality control, quality audit and quality assessment but also by public organization like the Asian University Network-Quality Assurance (AUN-QA). It may also wish to apply for official accreditations or certifications from International professional affiliations or certified bodies such as Seoul Accord, Washington Accord for Engineering and Technology Courses, etc.

8. Twinning Program. A twinning arrangement through Memorandum of Agreement that extends beyond recognition of prior learning arrangement under the auspices of academic collaboration may be explored by UIC. The University's twinning programs with other leading universities both regionally and internationally may improve the quality of education and provide greater insights into international development. It is expected that it will enhance abilities to communicate international development issues, especially in curricular offerings, research and linkages. To achieve this, UIC must actively seek partnerships with foreign institutions in the following ways:

a) UIC to venture overseas by setting up program branches in other foreign universities, offering Philippine-brand tertiary qualifications to foreign students. Possible courses/degrees for this arrangement are Filipino language-, history- and culture- related. This way, foreign students do not need to move and study in the Philippines and still continue on their jobs/ studies in their countries while getting a Philippine academic degree or certificate on the side.

b) UIC to offer foreign courses/degrees that both local and international students can take and at completion gain the certificate/degree from the partner foreign institution. This way, the students can save time and money (as standard of living and cost of education in the Philippines is much cheaper) while earning an international degree. Possible courses/degrees for this arrangement are Mindanao and Asian Culture studies, and specialized vocational studies.

c) UIC can offer the first one or two years of a foreign degree and finish it in the partner foreign institution overseas, and get the foreign degree certificate upon completion. On the other hand, the first one or two years of a UIC course/ program can be taken by international students in partner foreign institutions overseas, and the final years completed in UIC. Both the UIC and partner foreign institution degree certificates may be gained by the student through this

arrangement. Various UIC programs such as Clinical Pharmacy, Engineering, ITE, etc. may be offered through this arrangement. This strategy is also envisaged to open doors for UIC to offer high technology – demanding courses like Biotechnology and Biomolecular Engineering, Forensic Science, Material Science, and Pharmaceutical Engineering, etc.

d) Versions of the above programs with online components / distance studies.

9. Mobility of Student and Faculty. The university should offer mobility opportunities within and outside the ASEAN Region to students and provide the necessary resources to undergo experiential learning and the practical application of knowledge across cultural skills. It should be able to develop a skills framework towards an ASEAN skills recognition framework. UIC will encourage faculty members who will teach abroad for faculty exchange or served as consultants. UIC may also invite professors from other countries to do academic works in the institution. The administration encourages and supports faculty and students to participate in international assemblies or activities for the promotion of one's culture and become active members of international organizations.

10. International Scholarships for Faculty and Students. UIC, as one of the leading universities in Mindanao, Philippines has to establish an attractive and sustainable scholarship program that can reward grants to students and faculty who wish to study in or visit partner universities in Asian regions. This program must also be facilitating the mobility of learners and visiting professors to UIC via partnerships with the respective education ministries of the scholars' countries to explore possibilities of more funding. UIC must also seek partnerships with multinational scholarship institutions and organizations like Fulbright, AusAID, IBM, Monaco, etc.

11. International Training Programs for Human Resource. To be efficient as an international university, UIC must establish both a short-term or long-term training programs and initiatives geared towards the understanding of various cultures, models and ways of doing things of peoples involved in cross-border mobility. The training includes understanding of technologies, teaching methodologies, philosophies and other psychological and social factors needed in immersion of an individual to a new cultural, technical and intellectual society. UIC must also consider Language and Cultural Bridging programs for students and faculty bound for international studies/scholarships.

12. Research and Publication Collaboration. UIC may seek to create research links with other leading universities to identify area of joint academic interest. It will take the lead in research activities in collaboration with both regional and internationally recognized institutions and industries. It is expected that faculty and students participates in international studies as researchers. UIC may organize and serve as venue for international conferences where research studies are presented and disseminated. It will continue to support university-based research activities with the objectives in mind on international research outputs, patents and research awards. UIC must identify faculty for Research and Development (R & D), in order to establish various R & D agenda available for undergraduate, graduate and faculty researches under close supervision by the R&D faculty.

13. Partnership and Linkages. UIC should develop international collaborative relationships and establish cooperation with other local and international HEIs and other organzations. To gain international recognition, UIC must actively engage in the following activities: a) Participation within and outside the ASEAN Region academic opportunities (forums, skills competition, etc) as a means to support its internationalization process; b) Establish academic alliances with renowned and outstanding Higher Education Institutions for joint -degree programs, twinning-programs, faculty and student exchange program, credit-transfer arrangement and cooperative research network to gain academic strength and recognition; and c) Regular communication and cooperation with HEIs and educational organizations.

14. Social Orientation and Community Involvement. UIC must establish an office that would be responsible for the sharing and understanding of cultural heritage of multicultural students and faculty through their active participation in activities that can foster better relationship and establish friendship and respect among peoples of diverse traits and orientations, specifically, psychological , political, and economic.

CHALLENGES vis-à-vis INTERNATIONALIZATION

The realization of the identified dimensions of development above is not going to be easy. Creation of targeted action plans that will specify concrete objectives and step by step strategies to be carried out by UIC academic community as well as its stakeholders will facilitate early implementation of iUIC. The following challenges are envisaged:

1. Promotion of RVM Brand of Excellence
   - Defining & realizing the RVM brand of excellence
   - Tradition vs. modernization
   - Idealism vs. materialism
   - Geographical location & culture

2. National Government Quality Standards of Education
   - Bureaucracy in CHED, PRC & other national educational agencies
   - TESDA/K to 12 to reduce poverty
   - Vagueness in policies, protocols in acquisition of fund, organizational hierarchy
   - Lack of systems prototype prior to implementation, e.g. OBE

3. International Standard of Curriculum Structure (OBE/AUN/UMAP)
   - Lack of professional international expertise
   - Restructuring & alignment of curricular offerings leading to research-based instruction
   - Standard credit transfer system
   - Local & international politic
   - Active involvement in the University Mobility in Asia and the Pacific (UMAP) to provide platforms for networking of the interests for academic and research cooperation activities

4. Instructional Materials Development
   - Costly training, technology & production
   - Lack of local experts to provide international perspectives
   - Lack of systems prototypes
   - Diversity of settings & culture in the blueprint, presentation, implementation, and evaluation of learning materials

5. ICT Development
   - Faculty (Professional Training, Industry Exposure)
   - Lack of ICT Equipment
   - Need to put up a stable, fully functional, and efficient ICT Infrastructures designed for international interaction
   - Lack of electronic curriculum resources and learning materials

6. Cross-Cultural Adaptation Program
   - Need to put up international office
   - Need to assign trained staff for overseas student counsel
   - Lack of sufficient language & cultural bridging course for foreign students and faculty
   - Need for one-stop shop for international admission, e.g. for visa requirements & approval, parallel course requirements

7. International Quality Assurance
   - Need for ISO accreditations
   - Costly and tedious accreditation processes & accreditations
   - Lack of process & operations manuals
   - Lack of staff to work on preparations & documentations for audit

8. Twinning Program
   - Need for benchmarking in reputable target partner foreign institutions
   - Drafting and signing of multilaterally and mutually beneficial MOUs and MOAs for the various offerings of twinning courses/ degrees
   - Non-parallel curricula with foreign course/program curricula
   - Lack of expert consultants and facilities & infrastructures that support the twinning courses
   -Need for local twinning arrangements with other local HEIs, such as the offering of language courses and programs

9. Mobility of Student/Faculty
   - Lack of student exchange and faculty fellowship guidelines
   - Vague credit transfer
   - Synchronization of academic calendar
   - International politics

10. International Scholarships for Faculty and Students
    - Need for affiliation with funding agencies
    - Issues on fees associated with scholarship applications, age requirements, and length of paid & allowed sabbatical leave
    - Local & international competitions
    - Coursework vs. Research

11. International Training Programs for Human Resource
    - Costly
    - Feedback; transfer of knowledge & technologies
    - Threat of brain drain
    - Issues re return service

12. Research and Publication Collaboration
    - Creation of R & D faculty and agenda
    - Lack of facilities, technologies & expertise
    - Costly
    - Local & international politics
    - Creation of research agenda between UIC and other global HEIs and funding companies / organizations

13. Partnership and Linkages
    - Membership with AUN
    - Lack of guidelines for partnerships with international HEIs & other educational agencies
    - Drafting & signing of MOUs & MOAs
    - Lack of protocols for international industry immersion for faculty & students
    - International politics

14. Social Orientation and Community Involvement
    - Need for international activities, such as culture-specific global forums, fellowship nights, etc.
    - Need for various culture studies to be embedded in the curricular offerings as electives
    - Lack of satellite offices stationed in various parts of ASEAN boundaries

- For community involvement: need to adopt communities as recipient of various iUIC social activities, need to offer scholarships for IPs, and need for a Mission School Program that will help alleviate poverty
- Lack of trained experts/ professionals to spearhead the conduct of the above activities

IMPLICATIONS

The outline presented herein organizes the implications and strategic priorities consolidated from the ASEAN Declaration, the ASEAN Vision 2020 and the ASEAN Charter which describe for an onward looking region, living in prosperity, peace and stability, bonded together in partnership and dynamic development. The Philippine academic sector is therefore essential to the ASEAN's commitment to build the ASEAN Community by 2015 as envisioned by ASEAN Leaders.

The Philippine Qualifications Framework (PQF) is our National Qualifications Framework (NQF) in the ASEAN Context. As we choose to align with ASEAN 2015 in level-headedness and practicality, institution should consider the framework that we determine in our autonomy. The framework lists the qualifications, places them in order of difficulty of learning outcomes, and necessitates that our educational institutions (public and private) build up these qualifications, which is, that they assemble the faculties, facilities, libraries, laboratories and the like to teach and educate students through apt educational programs to reach these qualifications.

Implications/Actions for Marian Ignacian Institution

a. Sustainable Human and Economic Development
   - Collectively produce a variety of competent individuals sought by the labor market.
   - Create new knowledge and technologies that ensure the global competitiveness of the countries. Each institutional type plays an important role in achieving the balanced development of Filipino citizens and the nation.

- Life and technical competencies/skills (including critical thinking skills) – an integrative GE program
- Competencies for Work: shift to learner outcomes based education/learning competency based educations;
- Enhanced Research capacity (in science and technology) for high end research that translates to technological innovations to propel the economy and solutions to the country's problems

b. Global Competitiveness of the Philippines
   - Awareness of key priorities of the profession and the government
   - Strengthen linkages with government regulatory bodies and professional organizations

c. Philippine Professionals and Global Market
   - Curricular reform responsive to global competitiveness assessment

d. ASEAN Economic Community 2015
   - Looking at ASEAN as a market (e.g., international student enrollment, employment opportunities for graduates)
   - Looking beyond OECD, Middle East, and US
   - Aligning with ASEAN+6 standards and market demands
   - Establishing linkages with ASEAN+6 Education and Industry Partners

e. Assessing Competitiveness Among Filipino Professionals
   - Parallel assessment of quality of graduates vis-à-vis (local, national, regional, international) competitors
   - Implement CHED, PRC guidelines
   - Conduct competitiveness assessment of graduates (tracer studies, exit interviews, industry FGDs)

f. Factors affecting Services competitiveness
   - Developing global mindset among graduates
   - Curricular programs responsive to both local and international demands
   - Focusing on developing core competencies (talents, skills, ideas, and Catholic values)
   - Emphasizing innovation

CONCLUSIONS

Embarking on this gigantic task of evolving into an international academic institution that responds to the creation of ASEAN community is a manifestation that indeed, UIC is being true to its vision, that is, "A Catholic university that envisions the transformation of society in response to the signs of the times." Just like many HEIs in ASEAN countries that started preparing for their own internationalization, UIC has started forging partnerships in research activities and curriculum development with some countries in Asia. This project iUIC is a process of social construction and human development within the bounds primarily of the regional scenarios. It is a challenging move since the education system such as that of a traditional school like UIC needs a lot of adjustments with and openness to the diverse histories and culture of the ASEAN communities. The international transformation is challenged by diversity of cultural, political and economic dimensions that define ASEAN nations. In reality, ASEAN integration and "oneness" in academic policies truly need the strong support and cooperation of local and international educational institutions.

Vigilant of the changes in times, UIC has tailored to uphold universal values among its graduates. As a Catholic university, it accepts facing a more difficult task of demonstrating its mission to provide a holistic, quality and competitive educational system to answer the call of the globalization process which includes "serving others with humility and love; respecting the dignity of persons especially the poor; working for justice, promoting peace and preserving the integrity of creation." Through the promotion of Ignacian Marian education to international students, while at the same time embracing the demands of the global academic setting, internationalized UIC needs to be committed and patient towards the realization of this vision, despite all the risks. Understanding that all these implementations can only be realized through collective appreciation of the innate intentions of the ASEAN community leaders, UIC must adopt an "open-mind" stance to embrace the evolutionary nature of the entire process of globalized education. Thus, considering the state of affairs of UIC academic structures with all of its capabilities and potentials, there is no doubt at all that UIC as an international academic institution is now fully throttled to reach out globally as a major HEI supporting ASEAN Integration 2015.

REFERENCES

ASEAN Secretariat (2009). Roadmap for an ASEAN community 2009-2015. Retrieved from http://www.asean.org/wp-content/uploads/images/ASEAN_RTK_2014/2_Roadmap_for_ASEAN_Community_20092015.pdf

ASEAN Secretariat (2012). ASEAN 5-Year Work Plan on Education (2011-2015). Retrieved from https://www.scribd.com/doc/116508108/ASEAN-5-Year-Education-Work-Plan

ASEAN Secretariat (2014). ASEAN integration by 2015 and its implications to education in the region. Retrieved from https://www.scribd.com/document/264867842/ASEC-ASEAN-Integration-and-Implication-to-Southeast-Asia

Association of Southeast Asian Nations. (2012). The ASEAN socio-cultural community (ASCC) plan of action. Retrieved from http://asean.org/?static_post=the-asean-socio-cultural-community-ascc-plan-of-action

Campos, J.P. (2013). Fund for Assistance to Private Institution. ASEAN and Philippine Private PHEIs. Retrieved from http://www.fape.org.ph/addons/tinymce/editor/media/confab2013/mats/9%20Dr.%20Jose%20Paulo%20Campos%20ASEAN%20and%20Philippine%20Private%20PHEIs.pdf

Commission on Higher Education (n.d.) Retrieved from www.ched.gov.ph/chedwww/index.php/eng/Information

Daft, R.L. (2001). Organization theory and design (10th ed.). South-Western College Publishing: Florence, KY. Retrieved from http://www.kvimis.co.in/sites/kvimis.co.in/files/ebook_attachments/Richard%20L.Daft%20Organization%20Theory%20and%20Design.pdf

Garcia, J.A. (2013). Framework for ASEAN 2015: A roadmap for schools. Retrieved from http://pacu.org.ph/wp2/wp-content/uploads/2013/06/Framework-for-ASEAN-2015-A-Roadmap-for-Schools-Dr-John-Addy-Gar.pdf

Judy, R.W. & D'Amico, C. (1997). Workforce 2020: Work and workers in the 21st century. Indianapolis, IN: Hudson Institute. Retrieved from https://eric.ed.gov/?id=ED409463

Manzala, T. (2013). Understanding the Qualifications Framework for ASEAN 2015: Opportunities and Challenges for Philippine Education. Plenary Talk of Atty. Teresita Manzala, Philippine Regulatory Commission chairperson (Dec.1, 2013)

McCarthy, R. (2013). ASEAN integration: let's not forget the implications for education. Education UNESCO. Retrieved from http://www.unescobkk.org/education/news/article/asean-integration-lets-not-forget-the-implications-for-education/

Ordinario, CU (2013). Is PH ready for ASEAN 2015? Retrieved from http://www.rappler.com/business/economy-watch/27807-is-philippines-ready-for-asean-2015

Tabora, J., SJ. (2013). Aligning QA and school competitiveness. Retrieved from https://taborasj.wordpress.com/2013/12/02/aligning-qa-and-school-competitiveness/

Top Universities (2014). Retrieved from www.topuniversities.com/university-rankings/asian-university-ranking/2013

Print ISSN 1656-0604
Online ISSN 2244-6532

Health and Technology

In Vitro Antioxidant and Reducing Properties of Flavonoid Extract from Leaves of Kulitis *(Amaranthus spinosus L.)*

Crislee M. Torio[1] and Lilian De la Merced[2]
[1]Manila Central University, Caloocan City, Philippines
[2]University of Santo Tomas, Manila City, Philippines
[1]Corresponding author's email address: crislee_torio@yahoo.com

ABSTRACT

Though a natural process, uncontrolled oxidation may lead to aberrances in biological systems or early spoilage of foodstuff and pharmaceuticals, necessitating the use of antioxidants and reducing agents. This study used experimental approach to produce flavonoid extract from *Amaranthus spinosus* leaves and test its antioxidant and reducing properties using ascorbic acid, sodium metabisulfite, and quercetin as positive controls. Determination of total phenolic and flavonoid content revealed 23.44 mg gallic acid and 58.26 mg quercetin equivalents per gram of extract, respectively. The extract's antioxidant activity in terms of free radical DPPH and non-radical H_2O_2 scavenging activities, and Fe^{+3} to Fe^{+2} reducing property all exhibit concentration-dependent manner, similar to those of the positive controls. F-statistics analysis of the data revealed no significant difference among the antioxidant activities of the four groups, indicating that the extract's antioxidant activity is comparable to those of ascorbic acid, sodium metabisulfite, and quercetin. However, in terms of ferric reducing power, the extract was revealed significantly different from ascorbic acid and quercetin in favor of the two controls, signifying that though the extract exhibits ferric reducing capacity, it is not comparable with that of ascorbic acid and quercetin. On the other hand, no significant difference was detected between the extract and sodium metabisulfite, showing that their ferric reducing powers are comparable. Thus, the leaves of *A. spinosus* make excellent source of dietary and medicinal antioxidants, and the extract can be a natural alternate for sodium metabisulfite in preserving foodstuff and pharmaceuticals that are prone to oxidation.

KEYWORDS: Pharmacognosy, antioxidant, reducing agent, flavonoid, Kulitis *Amaranthus spinosus L.*, Philippines

INTRODUCTION

Oxidation is the main process that causes living organisms to mature and die, and pharmaceutical products to deteriorate. It can be retarded by anti-oxidation and/or reduction. In biological system, substances that add oxygen to or remove hydrogen from a molecule, rendering it reactive are oxidizing agents or oxidants; whereas substances that introduce hydrogen to or remove oxygen from a reactive molecule, making it stable are reducing agents. Oxidation and reduction often go together in cells but if the former becomes uncontrolled brought by pro-oxidants, the cells can have untimely death. Oxidative stress happens when there is an imbalance between the generation of pro-oxidant reactive oxygen species (ROS) and the activity of the natural antioxidant defense in the body (Murray, 2009). A normal healthy individual survives oxidative stresses because the cells are equipped with enzymes that are capable of breaking down ROS. However, constant exposure to pro-oxidants and to what triggers their activation would cause ROS accumulation, which can overwhelm the cell.

The most vulnerable cellular targets for free radical ROS oxidation are the enzymes, lipids in cellular membranes, and DNA which carries the genetic information (Haliwell, 1999). As such, ROS are known initiators and mediators of many cancers and heart diseases (Kohen, 2002), endothelial dysfunction, inflammation, brain degeneration (Cook, 1996) and even diabetes (Kumpulainen, 1999). The oxidative process hastens cellular aging (Kohen, 2002) that eventually leads to cellular damage which is responsible for the likelihood of diseases and cell death (Ames, 1993).

Currently, several treatment strategies employing antioxidants and reducing agents as adjuncts to therapies are being explored. For instance, it has been proposed that the tripeptide glutathione (GSH) is depleted in Human Immunodeficiency Virus (HIV) infection and clinical trials using N-acetylcysteine, a known GSH replenisher, showed improved immune functions in HIV-infected individuals (Staal, 2000). Furthermore, antioxidants are now important treatment modalities for shock, inflammation and ischemia or reperfusion injuries (Cuzzocrea, 2001).

Also, because of their perceived importance in the maintenance of health and beauty, commercially available antioxidant food supplements are proliferating. The cheapest commercially available antioxidant is vitamin C, a usual part of prescriptions for respiratory and soft tissue infections because it strengthens the immune response. A person who wants to maintain youthfulness and strength takes combinations of it with two other antioxidant vitamins A and E. These

vitamins scavenge free radicals by being themselves subject to oxidation, sparing the cellular components (Kohen, 2002).

However, the use of antioxidant supplements can be financially burdensome. In spite of its availability, its use is limited to those who can afford it. Another concern is the use of synthetic antioxidants such as butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), and sodium metabisulfite ($Na_2S_2O_5$) as these synthetic antioxidants have been found to be toxic to a certain extent. Thus, there is a need to find other sources of safe and natural antioxidants that can be obtained from materials that are cheap and are constantly available.

The best antioxidant diet is one that consists of a variety of different colored fruits and vegetables. Flavonoids in plants are known to function as color definitions and attractants to pollinators. Flavonoids are plant constituents that are reported to have antiviral, antifungal and anti-inflammatory activities (Evans, 2005) which are related to their antioxidant property (Cook, 1996; Yang, 2008) and the antioxidant activity was found to be directly related to phenolic content (Elmastas, 2006; Pourmorad, 2006). Many plant families contain flavonoids and they are widely distributed in nature. In particular, plants that belong to the Amaranthaceae family are known to possess flavonoids.

In the Philippines, one somewhat famous yet underutilized member of the Amaranthaceae family is Kulitis *(Amaranthus spinosus, L)*, a common weed, known as the local spinach. It is known to contain flavonoids and thereby possibly possess antioxidant activity. In this study, flavonoid extract was prepared from *A. spinosus* leaves, the plant's edible part. This study also elucidated the prepared extract's antioxidant activity against two known pro-oxidants: the free radical 1,1-diphenyl-2-picryl-hydrazyl (DPPH) and the non-radical hydrogen peroxide (H_2O_2), as well as the extract's reducing power. This is to test the hypothesis that flavonoid extract from *A. spinosus* leaves has radical and non-radical scavenging activities, as well as reducing properties that have no significant difference with three known antioxidants namely ascorbic acid, sodium metabisulfite and quercetin. The results of this study could elevate the use of Kulitis to not only as an affordable source of dietary antioxidants but also as a natural source of antioxidant for pharmaceutical use.

Study Objectives. This study investigated the DPPH and hydrogen peroxide scavenging activities, and reducing power of *A. spinosus* flavonoid extract (ASFE). It specifically determined the: 1) percentage of flavonoid that can be extracted from *A. spinosus* leaves; 2) physical and chemical properties, and the functional groups present in ASFE; 3) total phenolic and flavonoid content of the ASFE; 4) dose of ASFE that is lethal to 50% of the population Swiss mice as test animals

(LD_{50}); 5) radical and non-radical scavenging antioxidant activity and reducing property of ASFE; 6) significant difference between the antioxidant activities and reducing properties of ASFE and three known antioxidants as positive control, namely ascorbic acid as vitamin antioxidant, sodium metabisulfite as inorganic antioxidant, and quercetin as natural antioxidant.

METHOD

This study employed quantitative experimental design to produce flavonoid extract from *A. spinosus* leaves and compare its effectiveness as antioxidant and reducing agent with three known antioxidants (ascorbic acid, sodium metabisulfite, and quercetin) as positive control. The leaves of *A. spinosus* were collected from Bulacan. A mounted sample of the whole plant was submitted to the Botany Division of the Philippine National Museum for authentication. All subsequent experimental procedures were conducted at the Graduate Pharmacy Laboratory and the Instrumentation Room of the Purificacion Gallego-Tanchoco Building of Manila Central University in Manila.

Determination of percentage yield of flavonoid in *A. spinosus* leaf extract

The leaves were oven dried at 65°C, ground and defatted using petroleum ether, then air dried, and stored in clean and dry bottles prior to extraction. The *A. spinosus* flavonoid extract (ASFE) was prepared following the method of Harborne (1984). Fifty grams of dried ground leaves was subjected to continuous extraction for 24 hours at 60°C using 70% ethanol as solvent. The extract was concentrated by rotary evaporation, dried at 60°C over a steam bath, dissolved in water, then extracted thrice with ethyl acetate. The concentrated extract was recovered using soxhlet extractor.

Determination of physico-chemical properties and functional groups of ASFE

Physical properties. The organoleptic properties (physical appearance, state, texture, odor and color) of ASFE were evaluated by inspection only. The pH was determined by pH meter; while standard methods were used to determine

solubility in different solvents including water, ethanol, ether, chloroform, carbon tetrachloride and petroleum ether.

Chemical tests. Standard Tests for Carbohydrates using Molisch's Test, Fehling's Test, Test for Pentoses, Seliwanoff's test, and Keller-killiani Test were conducted (Evans, 2005). The methods of Gambalan (2007) and Guevarra (2004) were followed in the tests for the presence of free plant acids, fixed oils, and phytochemicals glycosides, saponins, alkaloids, flavonoids, and tannins. The confirmatory tests for Flavonoids were conducted using Wilstater Cyanidin Test and Bate-Smith and Metcalf test (Guevarra, 2004).

Functional groups. A sample of ASFE was submitted to De la Salle University (DLSU) Department of Chemistry for infra-red (IR) analysis by IR Spectroscopy to determine the functional groups present in ASFE. The spectra was interpreted by comparing it with standard functional group frequencies and bands reported in books to find possible functional groups present that may be used to identify probable active constituents in the extract.

Determination of total phenol and total flavonoid content of ASFE

Total phenol. Total phenols were determined with Gallic acid as a reference standard using Folin Ciocalteu reagent. In separate tubes, the standard and ASFE were mixed with Folin Ciocalteu reagent and 4 mL 1M Na_2CO_3. The mixtures were allowed to stand for 15 minutes and the total phenols were determined by colorimetry at 765 nm using spectrophotometer. The standard curve was prepared using 0, 50, 100, 150, 200 and 250 mg/L solutions of gallic acid in methanol and water (50:50, v/v) (Marinova, 2006). Total phenol value was expressed in terms of gallic acid equivalents.

Total flavonoid. Aluminum chloride colorimetric method was used for flavonoids determination. ASFE (10 g/L, 0.12 mL) and the quercetin standard (0.05 g/L, 0.12 mL) were treated with 0.12 mL of aluminum chloride in 95% ethanol (20 g/L), diluted with ethanol, and let stand for 40 min at 20°C. The absorbance was measured at 415 nm using spectrophometer against a blank prepared with one drop of acetic acid diluted with ethanol (Marinova, 2004). Total flavonoid content was calculated as quercetin equivalents (mg flavonoid/g of sample).

Toxicological test or lethal dose 50 determination (LD_{50}) of ASFE

Under proper use and care of experimental animals, Swiss mice weighing 16-24 g were used in the toxicological testing of the extract. Forty mice were grouped into five with four males and four females per group. Different doses of ASFE starting at a dose of 10mg/kg and increments of 0.6 log doses were administered by oral gavage. The number of deaths in a period of seven days was recorded. Lethal dose (LD_{50}) was computed by the Probit method (Bernas, 2004).

In vitro test for antioxidant property of ASFE

All tests were performed for ASFE and the three controls: sodium metabisulfite as inorganic antioxidant, quercetin as natural antioxidant, and ascorbic acid as vitamin antioxidant. Tests were done in triplicate to ensure validity of results.

Free radical scavenging activity by DPPH scavenging assay. This procedure is based on the method of Bakar (2009). A 0.1 mM solution of DPPH in methanol was prepared and 1 mL of this solution was added to 3 mL of different concentrations of the ASFE. The mixture was shaken vigorously and allowed to stand at room temperature for 30 minutes. Then the absorbance was measured at 517 nm using spectrophotometer (Bakar, 2009). Controls were prepared and tested in the same manner. The free radical scavenging activity was expressed as percentage DPPH scavenging activity or percentage inhibition.

Non-radical scavenging activity by hydrogen peroxide (H_2O_2) scavenging assay. This procedure is based on the method of Ruch (1989). A solution of H_2O_2 (40 mM) was prepared in phosphate buffer (pH 7.4). The concentration of H_2O_2 was determined by absorbance at 230 nm using spectrophotometer. The ASFE and the three controls were prepared in phosphate buffer. Equal amounts of ASFE and controls were added to the H_2O_2 solution (0.6 mL). These solutions were then kept at room temperature for ten minutes. Absorbance readings were obtained at 230 nm against a blank solution of phosphate buffer with hydrogen peroxide, and used to calculate the percentage H_2O_2 scavenging activity or percentage inhibition.

Reducing property by ferric reduction assay. The total reducing power of ASFE was determined based on the method of Oyaizu (1986). ASFE and the three controls were prepared at different concentrations using phosphate buffer

(2.5 mL, 0.2M, pH 6.6). Potassium ferricyanide [$K_3Fe(CN)_6$] (2.5 mL, 1%) was added then the mixture was incubated at 50°C for 20 minutes. Trichloroacetic acid (2.5 ml, 10%) was then added then the mixture was centrifuged for 10 minutes. The supernatant was mixed with distilled water and ferric chloride (0.1%), and the absorbance was measured at 700 nm using UV-Vis spectrophotometer. Higher absorbance of the reaction mixture indicates greater reducing power.

Statistical Analysis

Descriptive and inferential statistics were both employed in the study. Means and percentages of inhibitions were computed. Analysis of Variance (ANOVA/F-test) was used to determine if there is a significant difference in the antioxidant and reducing property of the extract compared to the different standard reducing agents and anti-oxidant at alpha level = 0.1. Groups that were found to be statistically different from each other based on F-test results were subjected to least square mean difference (LSMD) to determine which pairs of groups were significantly different from each other (Asaad, 2008).

RESULTS

The plant under study was identified and authenticated as Kulitis or Uray with scientific name *Amaranthus spinosus, L.* of the Amarnathaceae family by the Botany Division of the Philippine National Museum.

Percentage yield of flavonoid in ASFE

Flavonoid analysis on the Soxhlet extracted ASFE revealed considerable flavonoid content (table 1), that is, 5.14% considering many phytochemicals occur in lesser concentrations in plants.

Table 1. Percentage yield of flavonoid in ASFE

Trial	Weight of plant sample (g)	Weight of flavonoid extract (g)	% yield
1	50	2.48	4.96
2	50	2.82	5.64
3	50	2.41	4.82
Mean	50	2.57	5.14%

Physico-chemical properties of ASFE

Physical properties. Results of the physical tests on ASFE revealed that it possesses physical characterisics consistent with that of flavonoids (table 2). Flavonoids are known to be colored substances possessing a variety of colors from orange to magenta (Tyler, 1996). It has a characteristic very dark green color and sweetish odor. It is very viscous and approaches semisolid consistency. When totally dried it is a sticky and hard material.

Table 2. Physical properties of ASFE

Physical characteristics	Results
Organoleptic properties:	
Color	Dark green
Odor	Sweet odor
Texture	Viscous
pH	5 (weakly acidic)
Solubility in different solvents:	
Water	Very soluble
Ethanol	Very soluble
Ether	Insoluble
Chloroform	Insoluble
Carbon tetrachloride	Insoluble
Petroleum ether	Insoluble

The solubility of ASFE in polar solvents like water and ethyl alcohol is due to the presence of phenolic groups common to the flavonoid quercetin, which has been reported earlier to be present in *A. spinosus, L.* (Quisumbing, 1978). Phenols are semi-polar molecules which are soluble in alcohol and slightly soluble in water.

Chemical properties. Chemical tests on ASFE yielded positive results for reducing compounds, flavonoids and polyphenolic compounds but negative for plant acids, glycosides, alkaloids, tannins, and fixed oils. Confirmatory tests for flavonoids yielded positive result with Wilstater Cyanidin Test (table 3) establishing the presence of flavonoids in ASFE.

Table 3. Confirmation tests for flavonoid in ASFE

Name of tests (Constituent detected)	Visible positive result	Results obtained	Interpretation
Bates-Smith and Metcalf (Leucoanthocyanin)	Strong red color	Intense green	Absence of leucoanthocyanin
Wilstater Cyanidin (Flavonoids)	Red to crimson, occasional green to blue color	Intense green	Presence of flavonoids

The flavonoid in ASFE is not a leuconathocyanin as it gave a negative result with Bates-Smith and Metcalf test. This is due to the fact that quercetin, the flavonoid that was shown to be present in Kulitis, is not a leucoanthocyanin but a flavonol.

Functional groups. By IR spectroscopy, radial energy absorbed produces a spectrum with peaks corresponding to functional groups in a tested sample. The IR spectra for ASFE was interpreted by comparing it with that of the standard quercetin using the functional group frequencies and bands reported in books that correspond to functional groups depicted in the spectra. Table 4 summarizes the frequencies corresponding to the peaks shown by ASFE and quercetin, as depicted in their superimposed IR spectrograms in plate 1.

Table 4. Infrared frequencies of quercetin and ASFE

Quercetin band frequencies	ASFE band frequencies	Interpretation
3388.19	3410.82	Hydroxyl groups (–OH) present in alcohols and phenols (H-bonded); broad and strong intensity
1655.38	1629.67	Alkene groups (C=C) and carbonyl groups (C=O); variable intensity
1432.35	1400.37	Alkanes (–C–C–)
1080.69	1098.70	sp3 C–H bond

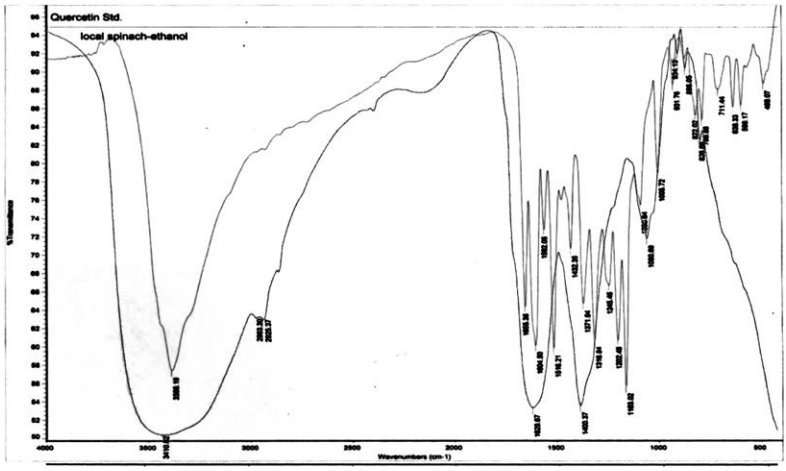

Plate 1. Superimposed IR spectra of ASFE (red) and quercetin (violet)

The superimposed IR spectra of ASFE and the standard quercetin underscores the similarity in their band frequencies corresponding to hydroxyl, alkenyl, and carbonyl specifically ketone groups and sp^3 hybridized carbon, which are the characteristic functional groups of flavonoids and polyphenolic compounds. The superimposed spectra show similar peaks, indicating that the extract is possibly quercetin with some impurities as suggested by the broad peaks especially between 3000-3500. The result of this infrared analysis confirms

the identity of the plant extract as a flavonoid, possibly quercetin. The seeming difference in the peaks may be due to the other flavonoids present as the extraction procedure employed was for the extraction of total flavonoid and not specific for the isolation of quercetin alone.

Total phenol and total flavonoid content of ASFE

The total phenol content of ASFE was expressed in terms of mg gallic acid equivalents per gram of ASFE (table 5). The mean gallic acid equivalent in ASFE, 23.44 mg/g, is much greater than that which was reported for other Amaranthus varieties such as, *Amaranthus caudatus* with 22 mg gallic acid/g and Amaranthus cruentus with 16.5 mg gallic acid/g (Repo-Carrasco-Valencia, 2010; Velioglu, 1998). The total flavonoid content of ASFE was calculated as mg of quercetin per g of sample, and presented in table 5. The obtained quercetin equivalent in ASFE, 58.261 mg/g, is lower than that which was reported for a plant of the same family, *Amaranthus caudatus* with 69.67 mg/g of sample (Velioglu, 1998).

Table 5. Total phenol and flavonoid content of ASFE

	Mean absorbance	Mean concentration (mg equivalents per g sample)	Equivalent standard used	Standard deviation
Phenol content	0.562	23.44	gallic acid	0.239
Flavonoid content	0.267	58.26	quercetin	1.539

Toxicity (LD_{50}) of ASFE

Since the flavonoid extract is being considered as both a source of dietary and pharmaceutical antioxidants, its lethal dose 50 (LD_{50}) needs to be determined, which is an important parameter for establishing the safety of natural products that have pharmacological value. The safety of ASFE was predicted by the Probit method. Based on the results of Probit analysis, the LD_{50} of ASFE is 441.20 mg/kg and the range of toxic concentration is 261.671-620.589 mg/kg. This result is on a dry weight basis of the plant sample. On a fresh basis this corresponds to a 127,574.45 mg/kg of the plant sample since the fresh leaves have 84.4% moisture. Therefore, the dose lethal to a 50-kg (110-lb) person is 6.25 kg of the fresh leaves.

This shows that fresh *S. spinosus* leaves are safe as source of dietary antioxidants when eaten as vegetables either raw or cooked as part of a dish, and the ASFE is safe as adjunct to foodstuff and pharmaceuticals that are prone to oxidation.

In vitro antioxidant and reducing properties of ASFE

The in vitro antioxidant activity was determined by radical and non-radical inhibition or scavenging properties of the antioxidants using DPPH and hydrogen peroxide, respectively; and the reducing power was determined using ferric to ferrous reduction capacity of the antioxidants. All the tests were performed for ASFE and the three controls ascorbic acid, sodium metabisulfite, and quercetin, in triplicates.

Free radical DPPH scavenging activity. DPPH scavenging activity was expressed as percent DPPH inhibition. Table 6 shows the computed percentage DPPH inhibitions of ASFE and the three controls with increasing antioxidant concentrations.

Table 6. DPPH Scavenging activity of ASFE and the control antioxidants

Initial conc. (mg/mL)	Final conc. (µg/mL)	Mean % Inhibition			
		ASFE	Ascorbic acid	Sodium metabisulfite	Quercetin
0.00	00.00	00.00	00.00	00.00	00.00
0.31	14.88	20.48	84.47	50.53	20.46
0.63	29.76	31.00	87.37	55.52	42.54
1.25	59.52	37.66	89.93	58.84	44.85
2.50	119.05	52.67	91.41	72.72	52.05
5.00	238.10	61.83	92.21	77.34	67.06
10.00	476.19	77.59	96.25	88.73	86.35

The antioxidant activities of ASFE and the three controls are concentration-dependent, i.e. increasing activity with increasing concentration. Ascorbic acid shows the highest DPPH inhibition with the lowest dilution followed by sodium metabisulfite. ASFE and quercetin show close DPPH inhibitions, which is expected as quercetin is the reported flavonoid that is present in the leaves of *A. spinosus, L.*

Plotting the concentration-dependent DPPH inhibition of the antioxidants show their inhibitory concentrations to fifty percent (IC_{50}) of the DPPH free radical (figure 1). As depicted, 50% of DPPH can be inhibited by 108.49 µg/mL ASFE or 104.02 µg/mL quercetin, but only by 8.81 µg/mL ascorbic acid or 14.77 µg/mL Sodium metabisulfite.

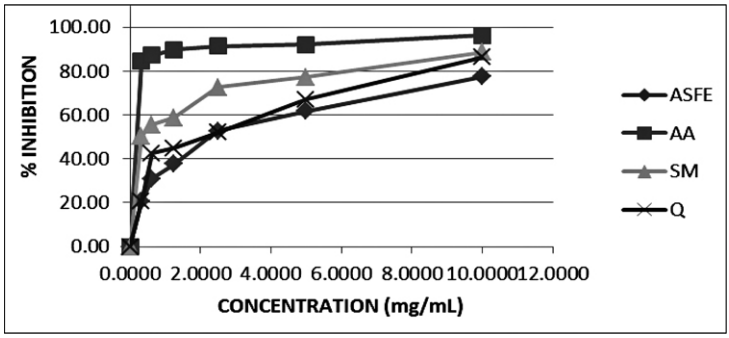

Figure 1. Concentration-dependent DPPH scavenging activities of ASFE, ascorbic acid (AA), sodium metabisulfite (SM), and quercetin (Q)

Non-radical H_2O_2 scavenging activity. The non-radical scavenging activities of ASFE and the three controls were evaluated using hydrogen peroxide as the non-radical ROS. Table 7 presents the percentage hydrogen peroxide (H_2O_2) scavenging activities of ASFE and the controls at different concentrations.

Table 7. Hydrogen peroxide scavenging activity of ASFE and the control antioxidants

Initial conc. (mg/mL)	Final conc. (µg/mL)	Mean % Inhibition			
		ASFE	Ascorbic acid	Sodium metabisulfite	Quercetin
0.00	0.00	00.00	00.00	00.00	00.00
0.31	150	23.59	35.67	39.14	36.34
0.63	300	27.31	36.69	39.97	36.04
1.25	625	31.39	37.32	40.24	36.78
2.50	1250	33.90	38.12	41.16	37.48
5.00	2500	37.55	38.35	42.04	38.18
10.00	5000	40.80	39.99	43.24	38.87

The percentage hydrogen peroxide inhibition of ASFE and the three controls were concentration-dependent. However, the prepared dilutions for ASFE and the controls were not able to scavenge 50% of the hydrogen peroxide. Thus, IC_{50} of hydrogen peroxide for the four antioxidants cannot be calculated. Nevertheless, figure 2 illustrates their concentration-dependent actions. The highest percentage H_2O_2 inhibition was observed with sodium metabisulfite at 43.24% using the highest concentration, followed by ASFE which gave a percentage inhibition of 40.80%. The other two controls, ascorbic acid and quercetin gave percentage inhibitions of 39.99% and 38.87% respectively at highest concentration.

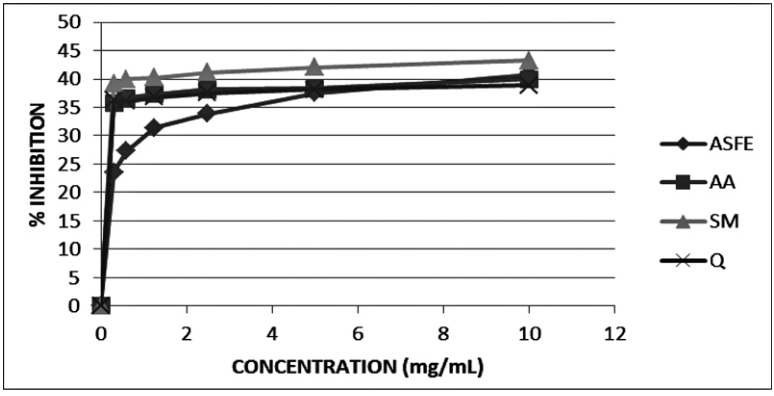

Figure 2. Concentration-dependent hydrogen peroxide scavenging activities of ASFE, ascorbic acid (AA), sodium metabisulfite (SM), and quercetin (Q)

Ferric to ferrous reducing property. Reduction is another mechanism by which an antioxidant is able to retard oxidation. The reducing properties of ASFE and the three controls were determined by measuring ferric to ferrous [Fe (III) to Fe (II)] conversion at 700 nm by spectrophotometry, and percent reduction were calculated at increasing concentrations (table 8).

Table 8. Ferric reducing property of ASFE and the control antoxidants

Initial conc. (mg/mL)	Final conc. (µg/mL)	Mean % Reduction			
		ASFE	Ascorbic acid	Sodium metabisulfite	Quercetin
0.00	0.00	0.00	0.00	0.00	0.00
0.31	16.67	13.29	6.44	7.64	19.14
0.63	33.33	14.17	13.07	10.29	38.87
1.25	69.44	19.52	27.01	12.16	44.12
2.50	138.89	29.19	60.17	28.72	45.70
5.00	277.78	33.78	66.76	31.93	67.20
10.00	555.56	55.31	70.91	57.06	70.24

The capacities of ASFE and the control antioxidants to reduce Fe (III) to Fe (II) were all concentration-dependent, with quercetin exhibiting the highest percent reduction at the least concentration, followed by ASFE. The concentrations that were able to reduce fifty percent of the ferric ion (RC_{50}) were calculated for each antioxidant, and revealed that ascorbic acid has the highest RC_{50} reducing power (at only 114.49 µg/mL concentration), followed by quercetin at 166.01 µg/mL. ASFE and sodium metabisulfite exhibit RC_{50} at 486.98 µg/mL and 478.59 µg/mL, respectively, as depicted in figure 3.

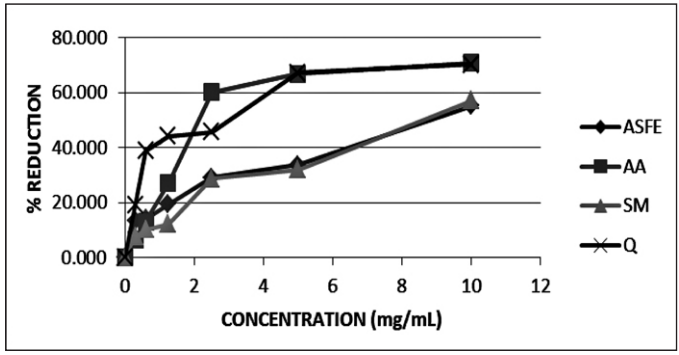

Figure 3. Concentration-dependent ferric reducing properties of ASFE, ascorbic acid (AA), sodium metabisulfite (SM), and quercetin (Q)

Significant difference between antioxidant and reducing properties of ASFE and the controls

To compare the free radical DPPH scavenging activity of ASFE with known antioxidants ascorbic acid, sodium metabisulfite, and quercetin, the data obtained was subjected to F-statistics analysis, to determine significant differences between the four groups. Calculations were done at an alpha level of 0.01 where the tabular F is 7.59. Since F tabular is greater than the computed F value (0.48, table 9), there is no significant difference in the inhibitory capacity of the different antioxidants to scavenge the DPPH radical, indicating that ASFE's antioxidant activity, in terms of DPPH inhibition, is comparable with those of the known antioxidants used as positive control.

Table 9. Comparison of the DPPH scavenging activities among ASFE and the control antioxidants

Sources of variation	Degrees of freedom	Mean squares	F, computed	Interpretation
Between groups	3	10561.37	0.48	Not significant
Within groups	8	21749.77		

To compare the ferric reducing property of ASFE with known antioxidants ascorbic acid, sodium metabisulfite, and quercetin, F-statistics analysis was conducted to determine significant differences between the four groups. The result revealed greater computed F (55.98, table 10) than the F tabular at alpha level of 0.01, which means that the differences in the reducing power of the compared antioxidants are significant.

Table 10. Comparison of the reducing properties among ASFE and the control antioxidants

Sources of variation	Degrees of freedom	Mean squares	F, computed	Interpretation
Between groups	3	12.8726	55.98	Significant
Within groups	8	0.2299		

To see which groups are significantly different, the data was further tested using the least mean square difference (table 11). The results revealed significant differences between the reducing power of ASFE with that of ascorbic acid and quercetin in favor of the two controls, indicating that though ASFE exhibits ferric reducing capacity, it's not comparable with that of ascorbic acid and quercetin. On the other hand, there is no significant difference between the reducing property of ASFE and sodium metabisulfite, indicating that the ferric reducing power of ASFE is comparable with that of sodium metabisulfite. In addition, the reducing properties of ascorbic acid and quercetin are not significantly different with each other, but are significantly different with that of sodium metabisulfite, in favor of ascorbic acid and quercetin.

Table 11. Least mean square difference in the reducing properties among the antioxidants

Groups compared	Mean difference	Interpretation
ASFE vs. Ascorbic acid	3.4601	Significant
ASFE vs. Sodium metabisulfite	0.1060	Not significant
ASFE vs. Quercetin	3.9422	Significant
Ascorbic acid vs. Sodium metabisulfite	3.3541	Significant
Ascorbic acid vs. Quercetin	0.4820	Not significant
Sodium metabisulfite vs. Quercetin	3.8362	Significant

DISCUSSION

This study was conducted to determine the value of the flavonoid from kulitis *A. spinosus, L.* as an antioxidant. The prepared *A. spinosus* flavonoid extract (ASFE) contains 5.14% flavonoids. A published study on a similar plant using the aerial parts has reported a slightly higher yield of 5.89% (Quisumbing, 1978). This is probably due to the other flavonoids present in the stem bark and other appendages of the plant, which may have contributed to the higher yield. The ASFE showed similar physical properties consistent with the flavonoids being soluble in polar solvents like water and alcohol but not in non-polar solvents like petroleum ether. Chemical tests on ASFE revealed and confirmed the presence of the polyphenolic constituent flavonoid with reducing property.

No plant acids were detected which may be because plant acids usually accumulate in the edible fruit rather than in the leaves; hence the acidic reaction of the blue litmus paper to red could not be due to the presence of plant acids but indicates presence of acidic phytochemicals or functional groups. Consistent to this, screening for carbohydrates on ASFE shows that they are not present although Fehling's test for reducing sugars turned out positive. This is because Fehling's test is not specific for sugars only but any material with reducing properties such as those that contain polyphenolic groups, gives a positive result. Flavonoids generally contain hydroxyl groups which can be oxidized to aldehydes and carboxylic acids, thus may explain the positive result obtained for Fehling's test. The prepared ASFE has reducing property but this is not due to carbohydrates but to the polyphenolic material that is present in flavonoids.

Remarkably, the negative result for saponins, which characteristically form persistent foams when exposed to air (Guevarra, 2004), indicates that the extract can easily be handled because the presence of saponins will make it difficult to either concentrate or dilute the extract. Also, tannins are tested not present in ASFE. Tannins are secondary plant metabolites that are also polyphenolic and are able to complex proteins and reduce substances, thus, if present may affect the antioxidant activity of the active flavonoid in ASFE. In addition, toxicological tests showed that ASFE is relatively safe, with dose lethal to a 50-kg (110-lb) person being 6.25 kg of fresh leaves, indicating that the fresh leaves are safe for consumption as a good source of dietary antioxidant.

Flavonoid confirmatory test on ASFE revealed and confirmed that ASFE's polyphenolic flavonoids with reducing property is not a leucoanthocyanin but flavonol, which is consistent with published literature that *A. spinosus, L* leaves contain the flavonoid quercetin, a member of the flavonols. The structural characteristics of the flavonoid extract as revealed by IR spectroscopy were similar to the flavonoid quercetin. Consistently, determination of the total flavonoid content of ASFE revealed 58.261 mg quercetin equivalents/g of ASFE. Further, ASFE tested to contain considerable amount of phenolic compounds (23.443 mg gallic acid equivalents/g ASFE), which could contribute to its antioxidant activity since the phenolic content of flavonoids is known to be directly influencing its antioxidant activity.

The antioxidant activity of ASFE shows a concentration-dependent manner when tested in vitro using DPPH and hydrogen peroxide scavenging assays. Statistical analysis of the data revealed that ASFE and the other controls (ascorbic acid, sodium metabisulfite, and quercetin) are not significantly different from each other in terms of DPPH scavenging activity, and therefore are comparable.

In terms of ferric reducing property, ASFE is not significantly different from sodium metabisulfite. Sodium metabisulfite is the most widely used antioxidant for both pharmaceuticals and foodstuff; however, it has been found to cause allergies and even toxicities. Because of the safety of the flavonoid extract, it can be a safe alternative to sodium metabisulfite for the preservation of foodstuff and pharmaceuticals that are prone to oxidation.

Reactive oxygen species have been shown to be inhibited by other phenolic plant extracts in DPPH antioxidant assays (Barluado, 2013), and ROS have been associated with disease states such as heart diseases, and other cardiovascular disorders, GI diseases, brain degeneration, diabetes, eye diseases and post-ischemic pathologies. The safety and radical scavenging activity of ASFE makes it a possible addition to treatment strategies involving the use of antioxidants as adjuncts in the treatment of radical-triggered diseases.

REFERENCES

Ames, B.N., Shigenaga, K., Hagen, T.M. Oxidants, antioxidants and the degenerative diseases of aging. Proceedings of the National Academy of Science USA, vol. 90, 1993, 7917-7922.

Asaad, A. Statistics Made Simple for Researchers 1st Edition, (Manila, Philippines, Rex Publishing, 2008), 113.

Bakar, M.F.A., et al. Phytochemical and antioxidant activity of different parts of Bambangan (Mangifera pajang) and (Artocarpus odoratissimus), Food Chemistry, vol. 113, 2009, 479-483.

Barluado, M.J.G., Lagang, M.J.M., & Bosas, C.D.B. (2014). Antiangiogenic and Antioxidant Properties of Calamansi Citrus microcarpa Peel Ethanolic Extract. UIC Research Journal, 19(2).

Bernas, G.D., et al. A Guidebook to Plant Screening: Phytochemical and Biological, (Manila, Philippines, Research Center for Natural Sciences University of Santo Tomas, 2004), 106.

Cook, N.C., Samman, S. Flavonoids- Chemistry, metabolism, cardioprotective effects and dietary sources, Nutritional Biochemistry, vol. 7, 1996, 66-76.

Ibid. vol. 13, 1996, 66-76.

Cuzzocrea, S., Riley, D.P., Caputi, A.P., Salvemini, D. Antioxidant therapy: A new pharmacological approach in shock, inflammation and Ischemia/reperfusion injury, Pharmacological Reviews, vol. 53, 2001, 135-159.

Elmastas, M., Gulcin, I., et al. Radical scavenging activity and antioxidant capacity of bay leaf extracts, Journal of Iranian Chemical Society, vol. 3, 2006, 256-266.

Evans, W.C. Trease and Evans' Pharmacognosy 15th Edition, (Winsland House I Singapore, WB Saunders, 2005), 246-247.

Ibid. 193.

Gambalan, N.B., Boie, M.Y. Pharmacognosy with Plant Chemistry Laboratory Guide (Caloocan City, Philippines, Manila Central University, 2007), 14.

Guevarra, B.Q., et al. A Guidebook to Plant Screening: Phytochemical and Biological, (Manila, Philippines, Research Center for Natural Sciences University of Santo Tomas, 2004), 43.

Halliwell, B. Oxygen and nitrogen are pro-carcinogens. Damage to DNA by reactive oxygen, chlorine and nitrogen species: Measurement, mechanism and the effects of nutrition, Mutation Research, vol. 443, 1999, 37-52.

Harborne, J.B. Phytochemical Methods: A guide to Modern Techniques of Plant Analysis 2nd Edition, (New York, Chapman and Hall, 1984), 37-89.

Kohen, R. Skin antioxidants: Their role in aging and in oxidative stress- new approaches for their evaluation, Biomedical Pharmacotherapy, vol. 53, 1999, 181-192.

Kohen, R., Nyska, A. Invited Review: Oxidation of Biological Systems: Oxidative Stress Phenomena, Antioxidants, Redox Reactions and methods for their Quantification, Toxicologic Pathology, vol. 30:6, 2002, 621.

Kumpulainen, J.T., Salonen, J.T. Natural antioxidants and anticarcinogens in Nutrition, Health and Disease, The Royal Society of Chemistry, 1999, 178-187.

Marinova, D., et al. Total phenolics and total flavonoids in Bulgarian fruits and vegetables, Journal of the University of Chemical Technology and Metallurgy, vol. 40, 2005, 255-260.

Murray. Harper's biochem book

Olajire, A., Azeez, L. Total antioxidant activity, phenolic, flavonoid and ascorbic acid contents of Nigerian vegetables, African Journal of Food Science and Technology, 2011, 22-29.

Pourmorad, F., Hosseinimehr, S.J., Shahabimajd, N. Antioxidant activity, phenol and flavonoid contents of some selected Iranian medicinal plants, African Journal of Biotechnology, vol. 5, 2006, 1142-1145.

Quisumbing, E. Medicinal Plants of the Philippines. (Philippines: Katha Publishing Co., Inc., 1978), 448-449.

Repo-Carrasco-Valencia, R., Hellstrom, J., et al. Flavonoids and other phenolic compounds in Andean indigenous grains: quinoa (Chenopodium quinoa), Kaniwa (Chenopodium pallidicaule) and Kiwicha (Amaranthus caudatus), Food Chemistry, 2010, 128-133.

Staal, F. Antioxidant therapy in AIDS, European Journal of Clinical Investigation, vol. 30, 2000, 841-842.

Tyler, Varro E., et al. Pharmacognosy and Pharmacobiotechnology, (United States of America: Williams and Wilkinns, 1996), 287.

Velioglu, Y.S., et al. Antioxidant activity and total phenolics in selected-fruits and vegetables and grain products. Journal of Agriculture and Food Chemistry, 1998, 236-240.

Yang, R.Y., Lin, S., Kuo, G. Content and Distribution of flavonoids among 91 edible plant species, Asia Pacific Journal of Clinical Nutrition, vol. 17, 2008, 275-279.

Print ISSN 1656-0604
Online ISSN 2244-6532

Comparison of the Blood Alcohol Concentration Readings from the Improvised Low-Cost and Commercial Breath Analyzers

Renan P. Limjuco[1], Avee Joy B. Dayaganon, Mary Jane G. Barluado, Norilyn Joy M. Torcuator, Althea C. Alcampado, Rhemegen S. Gevero, Ann Lucile D. Mar, Louie R. Poliño, Rachel Joy Ramento, Karen Ann P. Templado, Shyra Ericka S. Tortor, and Margaret Ivy V. Utrera
University of the Immaculate Conception

[1]Corresponding author's email address: rlimjuco@uic.edu.ph

ABSTRACT

Increase in alcohol related injuries and accidents call for stricter implementation of anti-alcohol laws, which depends on consistent monitoring of public alcohol drinking. In this study, an improvised low-cost device that can be used to determine blood alcohol concentration (BAC) by detecting alcohol in a person's breath was developed. The BAC readings of 19 volunteer participants obtained using the improvised device, a commercial breathalyzer, and by blood laboratory analysis were compared. The participants were asked to drink 132 ml of tequila (80 Proof) and blow their breaths to both the commercial breathalyzer and the improvised breath analyzer after 20 minutes. At the same time, samples of their blood were collected for BAC laboratory analysis. The results gave mean values of 0.046%, 0.039% and 0.021% obtained by laboratory testing, improvised, and commercial devices, respectively, showing that the improvised breath analyzer BAC readings are closer to the laboratory result than the commercial breathalyzer readings are. There is significant difference between the BAC readings obtained with the commercial and improvised devises, which could be because the two devices employ different principles. Further tests and innovations on the improvised device must be done before it can be presented as alternative blood alcohol monitoring device.

KEYWORDS: Clinical laboratory, blood alcohol concentration (BAC), breath analyzer, improvised device, descriptive comparison, Philippines

INTRODUCTION

Worldwide alcoholic beverage production has grown steadily since 1970 (WHO, 1999 & 2014). Alcohol drinking is being claimed as a way to help relax and promote better social interaction. However, excessive drinking can lead to irresponsible acts, injuries, and even fatalities. One irresponsible act under the influence of alcohol is drink-driving, which is considered illegal in many jurisdictions. A person's risk of being involved in a traffic crash increases with the amount of alcohol consumed, and Involvement in fatal crashes is 11 times more likely for drivers with blood alcohol concentration (BAC) levels between 0.05 mg/dL (0.05%) and 0.9 mg/dL (0.09%), compared with drivers who have not consumed alcohol (Jones, 2010).

Law enforcement officers (LEO) are tasked to determine whether a person is driving under influence (DUI) of alcohol. It is not an offense as long as the person's BAC is below a certain limit, which differs across countries, and with different penalties applying for breaking the law. The BAC ceiling in America, Canada Brazil, Ireland, and Switzerland is 0.08%. In Australia, it is 0.05%, while in China, it starts from 0.02%, same with Russia and Sweden. The strictest is in Japan, where DUI is seen as an extremely shameful public act and imposes the BAC limit of 0.00% (Fell & Voas, 2014; Jones, 2010; Lao, 2015; Mendoza, 2013).

In the Philippines, the Republic Act No. 10586, a.k.a. "Anti-Drunk and Drugged Driving Act of 2013", sets a BAC limit of 0.05% for most motorists while 0.00% for drivers of public utility transportations, penalizing violators up to 20 years jail time and P500,000 fine. Under the Act, the LEO will order DUI suspects (i.e. committed a traffic offense like overspeeding etc. and smelled of alcohol with slurred speech) to go through three field sobriety tests (eye test, walk-and-turn, and one-leg stand). Failure in any of the tests is a prompt for the LEO to get the driver's BAC using an alcohol breath analyzer (ABA). To implement this, the Act also stipulates that within four months from its effectivity, the Land Transportation Office (LTO) and Philippine National Police (PNP) shall acquire sufficient ABAs of DOH FDA-based standards to be deployed to and utilized by LEOs nationwide. However, while not enough devices are deployed up to now, some LEOs bring the offender to the nearest laboratory or hospital for BAC test, which is time-consuming considering hospital protocols. BAC provides important objective information that may not be accurately obtained from a suspect's verbal report or delayed laboratory examination since alcohol remains detectable in the body for a period of hours

only (Skipper et al., 2013); hence the importance of having ABAs to measure BAC on the spot.

ABAs measure BAC based on similar principle of chemical redox reactions using potassium dichromate that changes color (yellow orange to green) when alcohol is present. One example, the portable Breathalyzers encase potassium dichromate and convert the degree of color change into the level of alcohol in the person's blood, and display it as the percent BAC in the LCD window. There are many low-priced personal breath alcohol analyzers available in the market but these serve more as novelty items rather than reliable BAC measuring device. The reliable ones that are designed to FDA specifications used by US and Canada police are expensive, ranging from P14,000 to P22,000 in price (Breathkey, 2010; Backtrack, 2010). Much as they are useful in giving fast and accurate BAC information that can be documented to prove acts of violation, reliable commercial breathalyzers are expensive for the Philippine government to provide in sufficient numbers to area police stations and road police officers.

We therefore see a need for a cheaper tool that can reliably measure BAC level. We developed an improvised low cost kit that can be used in BAC determination through breath alcohol detection, and wanted to test the hypothesis that our improvised breath alcohol analyzer would give BAC readings that are not significantly different from BAC readings taken by commercial breathalyzer and direct blood laboratory testing. Specifically, we aimed to a) design a theoretical basis for the improvised low cost breath analyzer; b) find out the BAC of selected human participants when tested using the commercial breathalyzer, improvised breath analyzer, and direct blood laboratory analysis; and c) compare the three groups of BAC readings and determine significant differences among them.

METHOD

In the first phase of this study, we employed experimental research design to produce our improvised low-cost breath analyzer by investigating the principles and technological basis used in existing commercial breath analyzers, and used these relevant knowledge in designing and developing our machine. In the second phase, we employed descriptive comparative approach to gather the needed data (i.e. BAC readings) using our improvised machine, the commercial Breathalyzer, and laboratory testing, to test if our machine can compare with them.

We purposively chose 19 healthy individuals, aged 18-25 years, as participants in the alcohol breath tests. For ethical consideration, they were properly oriented

and signed Informed consent forms to indicate their voluntary participation in the study prior to the conduct of the breath alcohol tests. We gathered them in one of our colleagues' Davao City residence for the alcohol consumption and breath tests. They were asked not to eat anything at least two hours before the gathering. Only very light meal that was standardized was allowed to be consumed by the subjects prior to alcohol intake. An invited medical expert was at hand to give medical attention if necessary. The duration of a session with a participant from orientation/conditioning to breath test / blood extraction and subsiding of body BAC was 2 – 4 hours. The liquor brand used in this study is the tequila (El Hombre, Tequila Silver) with 40% alcohol by volume or 80 Proof.

Development of the improvised breath analyzer

Based on the results of our investigation of the theoretical basis of commercial breathalyzer, we designed the improvised breath analyzer. Specifically, we used the principle behind Photovoltaic Assay which uses photocells and aqueous potassium dichromate with sulfuric acid and silver nitrate as catalysts, facilitating quick redox with alcohol and color change. The photocell creates an electric current proportional to the degree of the color change, which is monitored by the movement of a needle on a dial that indicates the BAC. Hence by trial and error, we conducted design experimentations to produce a device that can measure alcohol concentration on human breath based on redox reaction and photocell function. The device was assembled to measure the amount of light transmitted and the amount of electricity emitted by the photocell. The designing, experimentations, and development of the improvised breath analyzer were conducted in University of the Immaculate Conception (UIC), chiefly in the UIC Engineering Laboratory in Bonifacio Campus, Davao City, from September 2014 to January 2015, with breaks in between.

Determination of blood alcohol concentration (BAC)

We followed the protocol specified by the manufacturer of the commercial breathalyzer in taking the subjects' BAC using the commercial breathalyzer. To get the BAC readings of the subjects using the improvised breath analyzer, we asked them to blow indirectly through a straw into the solution that is stimulated to produce a redox reaction and any degree of color change that ultimately is reflected as the BAC reading on the device's display window.

Blood Extraction. Within 20 minutes after drinking alcohol when it is expected to be in highest concentration in the blood, we extracted blood samples from the participants using plain VacutainerTM by standard venipuncture method. We then immediately subjected the blood samples to laboratory analysis for determination of the participants' BAC.

Comparison and testing for significant difference

For the analysis and interpretation of the gathered data, we employed Microsoft Excel to visualize the comparativeness of the data obtained using the three approaches. To determine existence of significant differences, we used analysis of variance and post hoc multiple comparison test on the BAC readings obtained with the commercial and improvised breath analyzers and laboratory testing.

RESULTS

The improvised low-cost breath analyzer

The device was assembled to measure the amount of light transmitted and the amount of electricity emitted by the photocell. The lesser the amount of light transmitted the greater the electricity emitted by the photocell which is proportional to the alcohol concentration in human breath. The external features of the improvised device is presented in figure 1.

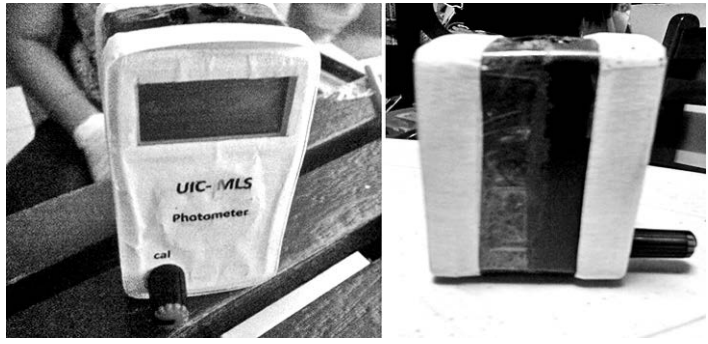

Figure 1. Front (left) and side (right) views of the improvised breath analyzer

The device is intended to measure alcohol concentration on human breath in percent. It measures the amount of light transmitted and the amount of electricity emitted by the photocell. The lesser the amount of light transmitted the greater the electricity emitted by the photocell which is proportional to the alcohol concentration in human breath. The improvised breath analyzer's specifications, important parts and their functions are presented in table 1.

Table 1. Specifications and parts of the improvised device

Feature	Description
Dimension	9 x 5.7 x 4.6 cm
Weight	100 g
Parts:	
Photocell	Narrows a beam of particles or waves
LED	For measurement in the visible and near-infrared ranges

With the specified features in table 1, we spent less than P300.00 for one improvised breath analyzer. This is much less compared to the price of commercial Breathalyzers at P15,000 to P22,000. With the main parts incorporated, the improvised device is expected to do its functional procedure in determining the level of BAC from a participant's breath based on the diagram in figure 2.

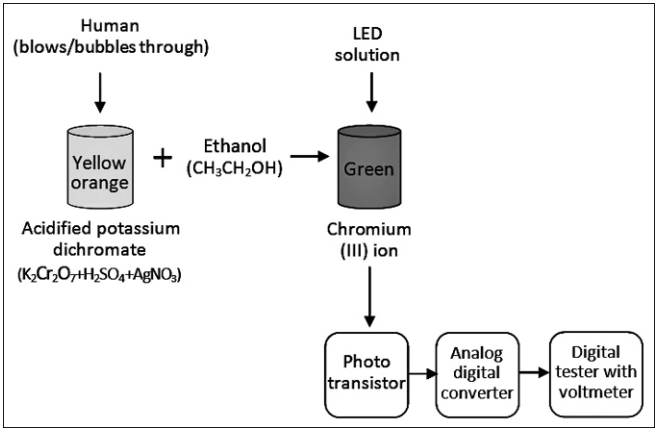

Figure 2. Schematic diagram of the functionality of the improvised breath analyzer

As shown in figure 2, the improvised device employs reduction-oxidation reaction and photometry. The solution is composed of potassium dichromate, sulfuric acid and silver nitrate. As the human breath with alcohol makes contact with the solution, the acidified potassium dichromate will be reduced to chromium (III) ion which gives a green coloration. The Light emitting diode (LED) will serve as the light source which emits a purple color. Green solution absorbs the purple light which makes lesser amount of light that will pass through. Lesser amount of light is then detected by the photocell which is a photo resistor. The lesser light detected greater will be the electricity produced which is proportional to the alcohol concentration in human breath.

BAC obtained by commercial Breathalyzer vs. improvised device vs. laboratory analysis

All 19 subjects consumed the same amount of alcohol under the same conditions. Both the commercial and improvised breath analyzers were used on the same subjects in getting their BAC. Also, the alcohol concentrations in their blood samples were obtained by laboratory analysis. The results are presented in table 2.

Table 2. Comparison of laboratory, commercial, and improvised breath analyzers' BAC results.

Cases	Blood alcohol concentration (BAC, g% w/v)		
	Laboratory	Commercial	Improvised
1	0.039	0.018	0.043
2	0.049	0.024	0.054
3	0.038	0.020	0.017
4	0.033	0.016	0.046
5	0.040	0.015	0.040
6	0.069	0.038	0.040
7	0.055	0.026	0.013
8	0.044	0.020	0.046
9	0.061	0.030	0.034
10	0.044	0.023	0.031
11	0.052	0.023	0.020
12	0.035	0.018	0.061
13	0.032	0.019	0.053
14	0.035	0.016	0.027
15	0.049	0.025	0.053
16	0.059	0.018	0.042
17	0.060	0.018	0.016
18	0.047	0.016	0.042
19	0.036	0.019	0.056
Mean	**0.046**	**0.021**	**0.039**
SD	**0.011**	**0.006**	**0.014**

We obtained higher BAC readings using the laboratory analysis (M = 0.046). Between the commercial and our improvised device, our improvised device obtained BAC readings (M = 0.039) that are closer to the laboratory. The commercial breathalyzer obtained much lower results (M = 0.021). This could mean lower sensitivity by the commercial breathalyzer compared with our improvised device, but needs additional tests to confirm.

The standard deviations for the three approaches are very close to zero (< 0.015) which means that the values are more consistent than not, which is expected since each case or participant underwent standardized pre-conditioning

and consumed the same amount of the same kind of alcoholic beverage. The difference could be attributed to the participants' individual metabolic rates and other biologic factors not under control by experimental standardization.

In figures 3a – 3c, we plotted the BAC readings per participant between each technique to visualize their comparativeness.

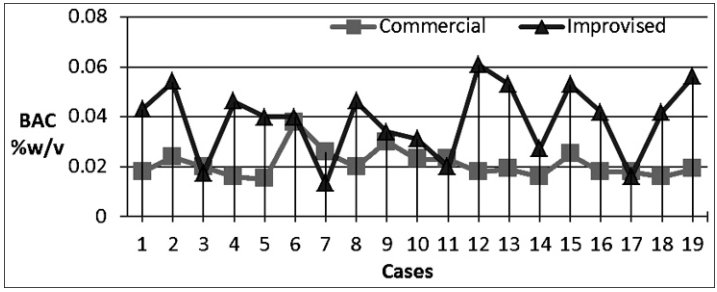

Figure 3a. Comparison between the commercial and improvised breath analyzers' BAC results

As shown in figure 3a, there are five cases out of 19 (26%, cases 3, 6, 9, 11, and 17) that the commercial and improvised breath analyzers gave very close results, as indicated by the intersections in the graph. Overall, higher BAC readings were obtained with the improvised device than with the commercial one.

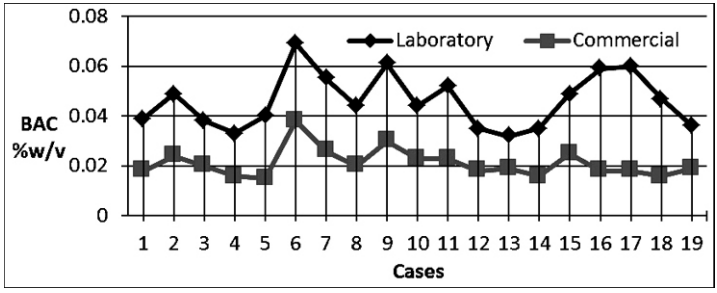

Figure 3b. Comparison between the laboratory and commercial breath analyzers' BAC results

The laboratory analysis generally gave higher BAC results than the commercial breathalyzer. Though the laboratory test and commercial breathalyzer results did not render the same BAC in any of the 19 participants, as indicated by non-intersecting graphs in figure 3b, their graphs show similar pattern from case 1 to case 15, which may indicate parallel results by both techniques, with the laboratory test being more sensitive than the commercial device.

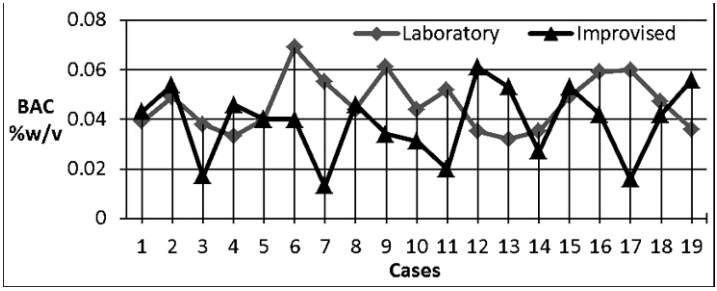

Figure 3c. Comparison between the laboratory and improvised breath analyzers' BAC results

As shown in figure 3c, there are six cases out of 19 (32%) that the laboratory and improvised breath analyzers gave very close results. These are cases 1, 2, 5, 8, 15, and 18, as indicated by the intersecting points in the identified cases. Overall, it cannot be established that the laboratory testing generally gave higher readings as there are cases (4, 12, 13, and 19) wherein much higher BAC was rendered by the improvised device.

Significant difference in BAC readings among the three techniques.

Table 3. Analysis of variance of BACs obtained by the three techniques

Technique	Cases	Mean (g% w/v)	SD	F	p-value
Laboratory	19	0.046	0.0269		
Improvised	19	0.039	0.0145	148.42	.000
Commercial	19	0.021	0.0057		

Analysis of variance among the three techniques' BACs revealed significant differences among them ($p < .05$, table 3), indicating that the BAC results obtained by laboratory analysis, improvised breath analyzer, and the commercial breathalyzer are not comparable with each other. Post hoc multiple comparison test reveals significant difference between laboratory-obtained BACs and device-obtained BACs (table 4).

Table 4. Multiple comparison test of BACs obtained by the three techniques

Techniques Being Compared	Difference	p-value
Laboratory vs. Improvised	.07692*	.000
Laboratory vs. Commercial	.09439*	.000

Results of the multiple comparison test, specifically LSD, have established that BAC measurements from laboratory results and from the improvised device are significantly different ($p < .05$). Likewise, BAC results from laboratory analysis and from the commercial device are significantly different ($p < .05$). These confirm the ANOVA results that BAC measurements taken by laboratory analysis are not comparable with BAC readings obtained by both the commercial and improvised devices, which themselves are non-comparable with each other.

DISCUSSION

The devices we used in this study serve the purpose of detecting the BAC although different results were obtained. This could be because the devices employ different methods in measuring the BAC. The three techniques are different with each other in terms of their sensor, in which the improvised apparatus uses photocells as the main detector for chemical reaction brought about by redox reaction of the reagents with exposure to breath alcohol, while the commercial device uses fuel cell, wherein platinum oxidizes any alcohol present in the exhaled air to produce acetic acid, protons and electrons. The more alcohol that becomes oxidized the greater the electrical current indicating higher BAC detected.

For laboratory detection, which we used as our standard in this study, no sensor is used. The principle of spectrophotometry is employed to determine BAC using a blood sample, not breath. Dr. Michael Hlastala, Professor of Physiology, Biophysics and Medicine at the University of Washington purports in his paper entitled Physiological Errors Associated with Alcohol Breath Testing, that breath testing is a very inaccurate method for measuring BAC. Even if the breath testing instrument is working perfectly, physiological variables prevent any reasonable accuracy. This is consistent with the results of Simpson (1987) who determined that breath readings vary at least 15% from actual blood alcohol levels, and at least 23% of all individuals tested will have breath results in excess of true blood alcohol levels, hence it would seem that if a conclusion is to be made about the BAC of a random subject, especially when the conclusion can have serious consequences, it would be far preferable to make it on the basis of a direct blood measurement.

However, other studies on the fate and disposition of ethanol in the body and the relationship between the number of drinks consumed and the resulting BACs (Jones, 2010; Simic & Tasic, 2008) show support in the use of breath analyzers in determining BAC. For instance, 2–5% of the total amount of alcohol a person consumes is eliminated from the body unchanged in breath, urine and sweat. Also, the concentrations of alcohol in blood and other body fluids are highly correlated, and laboratory and device measurements are widely used as evidence to prove the over-consumption of alcohol in forensic and legal medicine (Jones, 2010; Jones & Kugelberg, 2010). Another study on the variability of blood/breath alcohol ratio revealed high correlation between the two, supporting high diagnostic sensitivity of breath analyzers in field tests (Jaffe et al., 2013). Moreover, during absorption stage of blood alcohol, the breath-alcohol runs closer to the arterial BAC more so than to the venous BAC, which

lags behind (Lindberg et al., 2007 as cited by Jones, 2010), which can explain the lower sensitivity of laboratory analysis which uses venous blood.

The commercial breathalyzer has many significant limitations compared to our improvised breathalyzer. One, it is limited to only 1500 samples or tests. The warranty of the said commercial breathalyzer is just a year. It also requires immediate battery replacement when the battery indicator icon reaches one bar, which may hamper results when batteries are not immediately replaced. It also works only within temperature range of 32 to 104 degree Fahrenheit. Also, sufficient amount of air must be exhaled so that the device will give appropriate result. This device also requires 20 minutes before blowing; if this allotted waiting time period is not observed or followed properly, it may cause an inaccurate result and may also damage the sensor.

We also observed limitations with our improvised breath analyzer. As with the commercial breathalyzer, the participants in improvised breath analyzer must blow sufficient amount of air directly to the mixed solution. Its operation also depends on the commercial availability of the reagents. Nevertheless, our improvised breath analyzer could have exhibited more efficiency since it allows direct reaction with the reagent which readily results in change of color. In fact, the color change is observed soon as the participants bubble through to the reagent. It is more sensitive in the sense that a little change of color corresponds to the detection of alcohol level in the participant's breath.

Though the laboratory-determined BAC is the one considered confirmatory, laboratory testing can also have setbacks. Transporting of a specimen is time limited since more than one hour will yield a result of false decrease. Also, the availability of needed laboratory reagents is also a limitation in some instances since they may not be readily available in the market.

We acknowledge limitations in the setup in which we performed the tests with both the commercial and improvised devices. An individual's weight, gender, and alcohol consumption and absorption affect BAC levels (Aston & Liguori, 2013), thus grouping the participants according to gender, weight, alcohol consumption, and other variables would have given us more profound analysis, but this would have entailed having more participants.

Overall, our results indicate that the laboratory technique gives the highest sensitivity. Its only disadvantage is that it is inconvenient to the participants considering the blood extraction procedure. Also in reality, it is time consuming for both the driver and the LEO. Considering the laboratory analysis as the standard measurement, our improvised device comes closer to it than the commercial breathalyzer.

Our data cannot ascertain the accuracy of the improvised low cost breath analyzer, but in the absence or limited supply of the commercial device, production of more improved version of this innovation can serve the purpose of detecting the BAC, especially of those traffic offenders or at random checkpoints by LEOs deployed by both the LTO and the PNP for the purpose of teethed implementation of R.A. No. 10586, to promote road safety and avoid crimes and accidents attributable to alcohol drinking.

Recommendations. Based on the findings and conclusions of the study, we recommend a) further improvements on the physical design (such as developing a suitable container for the reagent and blowing apparatus to properly capture lung breath), b) involving more participants and grouping them according to different variables, for test result consistency and replicability, and c) having interfering factors during testing and BAC reading to investigate functionality of the improvised device in practical situations.

We acknowledge the valuable contribution of Mr Reynaldo P. Lugo, UIC Laboratories technical specialist, in the making of our improvised breath alcohol analyzer.

REFERENCES

Aston, E.R. and Liguori, A. (2013). Self-estimation of blood alcohol concentration: A review. PubMed. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3592207/

Breathkey. (2015). http://breathkeybreathalyzer.com/

Bactrack. (2015). https://www.bactrack.com/products

Department of Transportation and Communications (DOTC), Department of Health (DOH) and the National Police Commission (NAPOLCOM) (2014). Implementing Rules and Regulations of Republic Act No. 10586 "Anti-Drunk and Drugged Driving Act of 2013" http://www.gov.ph/2014/04/28/implementing-rules-and-regulations-of-republic-act-no-10586/

Fell, J.C. and Voas, R.B. (2014). The effectiveness of a 0.05 blood alcohol concentration limit for driving in the United States. Addiction. 109(6):869-874. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4448946/

Hlastala, M.P. (1985). Physiological Errors Associated with Alcohol Breath Testing. The Champion. Retrieved from http://www.mphlastala.com/Champion.pdf

Jaffe, D.H., Siman-Tov, M., Gopher, A., Peleg, K. (2013). Variability in the blood / breath alcohol ratio and implications for evidentiary purposes. Journal of Forensic Sciences (58): 1233-1237. DOI:10.1111/1556-4029.12157

Jones, A.W. (2010). Evidence-based survey of the elimination rates of ethanol from blood with applications in forensic casework. Forensic Sci Int. 2010 Jul 15; 200(1-3):1-20. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/20304569

Jones, A.W. (2010). The Relationship between blood alcohol concentration (BAC) and Breath alcohol concentration (BrAC). ResearchGate. Retrieved from http://www.researchgate.net/publication/266580842

Jones, A.W. and Kugelberg, F.C. (2010). Relationship between blood and urine alcohol concentrations in apprehended drivers who claimed consumption of alcohol after driving with and without supporting evidence. Forensic Sci Int. 2010 Jan 30;194(1-3):97-102. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/19942384

Lao, S. (2015). All you need to know about the Anti-Drunk Driving Law. Hospitality News. January 10, 2015 Issue. http://hospitalitynews.ph/1105/all-you-need-to-know-about-the-anti-drunk-driving-law/

Mendoza, A.S. (2013). Alcohol discontent. Philippine Daily Inquirer / 09:43 PM July 30, 2013. https://business.inquirer.net/135673/alcohol-discontent

Simic, M. & Tasic, M. (2007). The relationship between alcohol elimination rate and increasing blood alcohol concentration--calculated from two consecutive blood specimens. Forensic Sci Int. 2007 Oct 2;172(1):28-32. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/?term=Tasic

Simpson (1987). Accuracy and Precision of Breath-Alcohol Measurements for a Random Subject in the Post absorptive State, 33(2) Clinical Chemistry 261

Skipper, G.E., Thon, N., DuPont, R.L., Campbell, M.D., Weinmann, W., Wurst, F.M. (2014). Cellular photo digital breathalyzer for monitoring alcohol use – A pilot study. European Addiction Research (20):37-142. DOI: 10.1159/000355834. Retrieved from https://www.promises.com/wp-content/uploads

WHO (1999). Global Status Report on Alcohol. Retrieved from http://www.who.int/substance_abuse/publications/en/GlobalAlcohol_overview.pdf

WHO (2014). Global Status Report on Alcohol and Health. Retrieved from http://apps.who.int/iris/bitstream/10665/112736/1/9789240692763_eng.pdf

Print ISSN 1656-0604
Online ISSN 2244-6532

Development and Utilization of an Experimental Resonance Tube Setup with Laptop-Generated Sound Source

Alwielland Q. Bello
Bukidnon State University
Malaybalay City, Philippines
Email: alwielland@gmail.com

ABSTRACT

An experimental resonance tube setup consisting of an economy resonance tube, laptop computer, desktop speaker and digital thermometer was developed and utilized inside the physics classroom in the Bukidnon State University, Malaybalay City, Bukidnon. The experimental values of speed of sound vsound at room temperature were deduced through frequency-vs-harmonic number (f-vs-n) experiments. These experiments include open-pipe and stopped-pipe procedures in several trials. Room temperature has been found changing at different time intervals of the day and weather conditions so that frequency-vs-harmonic number (f-vs-n) were performed at different room temperatures at different time intervals.

KEYWORDS: Speed of sound, resonance tube, room temperature, frequency, harmonic number

INTRODUCTION

There are several models of resonance tube apparatus that are commercially advertised and distributed by known companies in the country and from abroad. One of these models is the Pasco Economy Resonance Tube Model WA-9495[1]. This is exclusively distributed by Pasco Scientific, Inc. The resonance tube is relatively affordable but requires other very expensive devices such as a function signal generator and open-type speaker. The resonance tube would be useless in performing resonance and normal mode experiments unless those aforementioned accessory devices are also purchased form the same company. Therefore it is our common interest to come up with a way to cut the cost, yet obtaining plausible results.

This study aims to develop an experimental resonance tube setup that is made up of locally available materials and devices; to utilize this experimental setup in the physics classroom through sound-related experiments and to determine the speed of sound at room temperatures during the different time intervals of the day. Nevertheless purchasing the resonance tube was allowed since it is very difficult to reproduce such with identical specifications.

Theory

When the diaphragm of a speaker vibrates, a sound wave is produced that propagates through the air. Sound wave consists of small motions of the air molecules toward and away from the speaker. If you were able to look at a small volume of air near the speaker, you would find that the volume of air does not move far, but rather it vibrates toward and away from the speaker at the frequency of the speaker vibrations. The motion of a small volume of air in a sound wave is parallel to the direction of propagation of the wave. Because of this, sound wave is considered as longitudinal wave.

We can consider a sound wave as a series of compressions and rarefactions. When the diaphragm of a speaker moves outward, the air near the diaphragm is compressed, creating a small volume of relatively high air pressure, a compression. This small high pressure volume of air compresses the air adjacent to it, which in turn compresses the air adjacent to it, so the high pressure propagates away from the speaker. When the diaphragm of the speaker moves inward, a low pressure volume of air, a rarefaction, is created near the diaphragm. This rarefaction also propagates away from the speaker. In general, a sound wave propagates out in all

directions from the source of the wave. However, the study of sound waves can be simplified by restricting the motion of propagation to one dimension.

Resonance is the condition of maximum energy transfer wherein the frequency of the energy source is the same as one of the natural frequencies of the vibrating body, causing the body to vibrate with maximum amplitude. Musical wind instruments like flute, trumpet, oboe, horn and a church organ are essentially made up of pipes or tubes, whether open or stopped, in which sound waves pass through.

For an open-pipe (both ends are open), resonance for a particular frequency occurs according to the equation[2]

$$f_n = \frac{nv}{2L} \quad ; \quad n = 1, 2, 3, \ldots \qquad (1)$$

where n is the harmonic number, v is speed of sound in air in m/s, L is the air column length in m, and f is any corresponding frequency in Hz. Note that in an open-pipe setup, all harmonics are present. For a stopped-pipe (one end is closed), resonance occurs as stated in the equation[2]

$$f_n = \frac{nv}{4L} \quad ; \quad n = 1, 3, 5, \ldots \qquad (2)$$

Note that only odd harmonics are present.

An air column length of a resonating frequency can be divided by the number of half-wavelengths present in a particular resonance state. Each harmonic number has a distinct pattern of standing waves passing through the pipe from one end to another. The location along the pipe that corresponds to minimum amplitude is called node. On the contrary, the location that corresponds to maximum amplitude of sound is called antinode. Since all harmonics is present in an open pipe of length L, the resonance states are illustrated in Figure 1.

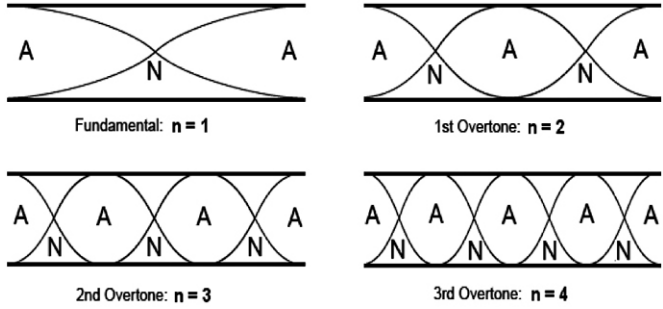

Figure 1. Resonance states of an open-pipe tube of length L.

However, only odd harmonics are present in a stopped pipe of length L. Thus the resonance states are limited as shown in Figure 2.

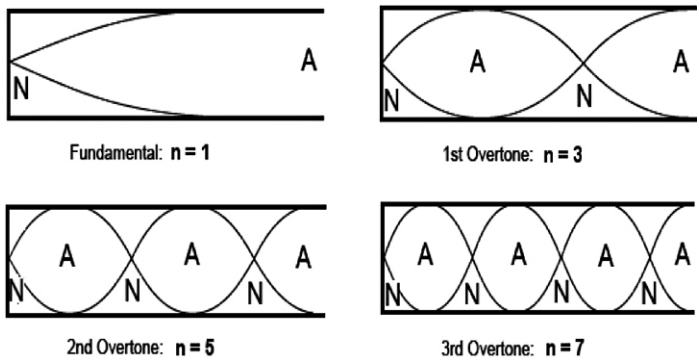

Figure 2. Resonance states of a stopped-pipe tube of length L.

It is known that speed of sound in air is a function of temperature. Therefore speed of sound is expressed in terms of the equation[2]

$$v = \sqrt{\frac{\gamma RT}{M}} \qquad (3)$$

where v is speed of sound in air (in m/s), γ is the heat capacity ratio of gas; for diatomic gases, γ = 1.40, *R* is the universal gas constant, 8.3145 J/mol-K, M is the molecular mass of air, 0.0288 kg/mol, and T is room temperature (in Kelvin).

METHOD

Figure 3 shows the block diagram of experimental resonance tube apparatus set. A laptop computer generates and passes the signal frequency to a desktop speaker. Aside from the laptop's sound card capabilities, the speaker has its own amplification just enough for the signal to be heard at close distances. All signal frequencies are generated by Adobe Audition version 1.5 software[3]. The speaker delivers the sound signal through the economy resonance tube, which is made up of an inner and outer hard cardboard tubes. An acrylic cap is placed to cover either edge of the inner tube when performing stopped-pipe experiments.

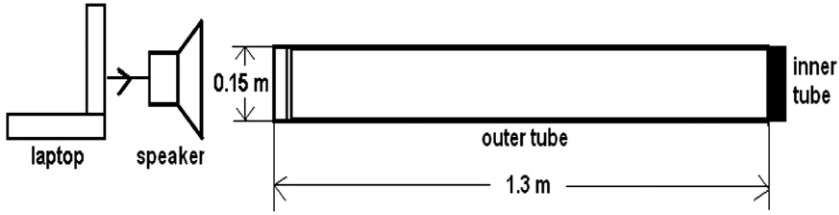

Figure 3. Block diagram of the experimental resonance tube setup.

The following steps are procedures being done in performing frequency-vs-harmonic number (*f-vs-n*) experiments: For open-pipe procedure, room temperature was recorded first at the start of every experiment. Both inner and outer tubes were free to resonate without obstruction. A speaker was placed closer to an open edge of the resonator tube. Sound intensity was set to minimum by adjusting the volume control of the speaker that is connected to the laptop. Tube set-up was set into a fixed length. Resonant frequencies were selected in the laptop computer. Resonance occurred as a selected frequency produced loud "hum" through the tube set-up. Additional frequencies were obtained as we select further in the laptop. These resonant frequencies were recorded corresponding to different harmonic numbers. Entire procedure was repeated in 5 trials. Record the room temperature at the end of every experiment. For stopped-pipe procedure, room temperature was recorded first at the start of every experiment. One edge of the inner tube was covered with an acrylic cap. The speaker was placed closer to an open edge of the resonator tube. Sound intensity was set to minimum by adjusting the volume control of the speaker that is connected to the laptop. Tube set-up was set into a fixed length by adjusting the inner tube. The acrylic cap served as rigid boundary for sound waves to bounce back toward the open edge of the outer tube. Resonant frequencies were selected in the laptop. Resonance occurred as a selected frequency produced loud "hum" through the tube set-up. Additional frequencies were obtained as we select further in the laptop. These resonant frequencies were recorded corresponding to different harmonic numbers. Entire procedure was repeated in 5 trials. Record the room temperature at the end of every experiment.

RESULTS AND DISCUSSION

The following figures show the superimposed frequency versus harmonic number *(f-vs-n)* plots of the data obtained from open-pipe and stopped-pipe procedures at different room temperatures. The data points are plotted using the latest Minitab version 16.1 software[4].

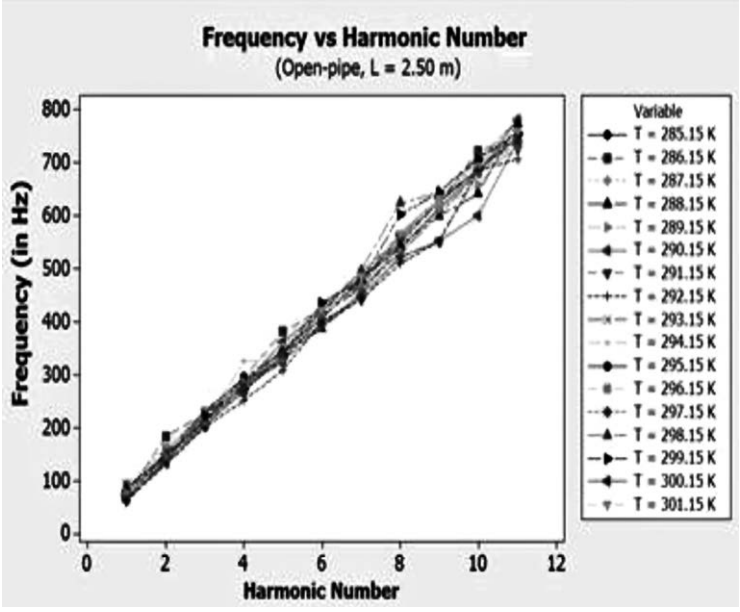

Figure 4. Superimposed frequency vs harmonic number plots using a 2.50 m open-pipe tube, at 285.15 K – 301.15 K room temperature range

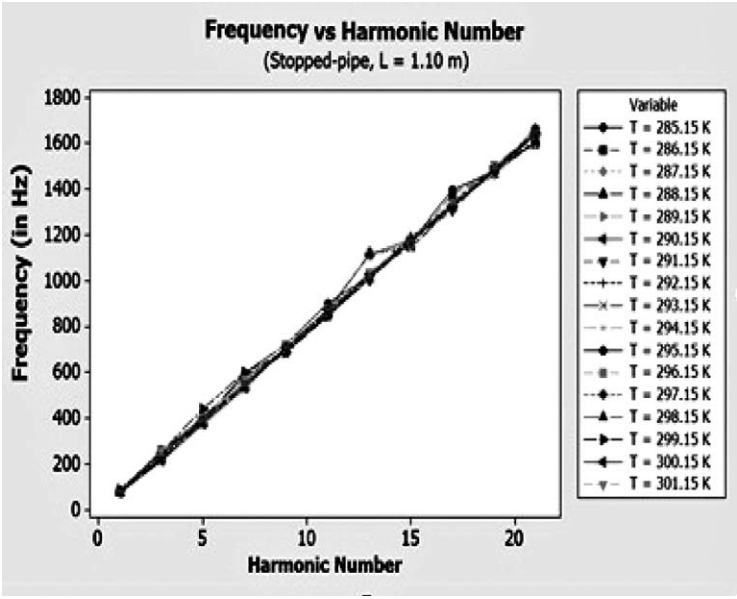

Figure 5. Superimposed frequency vs harmonic number plots using a 1.10 m stopped-pipe tube, at 285.15 K – 301.15 K room temperature range

The superimposed graphs in Figure 4 and 5 indicate a highly linear relationship between frequency and harmonic number variables for both open-pipe and stopped-pipe procedures. This general observation is also true with the individual plots that correspond to 17 different room temperatures. Tables 1 and 2 summarize the room temperature, deduced speed of sound, standard speed of sound and percent error, respectively.

Table 1. Standard and experimental values of sound speed obtained from open-pipe procedure at different temperatures

Temp. (K)	Stand. vsound (m/s)	Expt. vsound (m/s)	% error
285.15	339.49	342.33	0.84
286.15	340.08	334.53	1.63
287.15	340.68	343.46	0.82
288.15	341.86	327.84	3.93
289.15	342.27	328.43	3.92
290.15	342.45	313.72	8.39
291.15	343.04	342.34	0.20
292.15	343.63	325.29	5.34
293.15	344.22	330.53	3.98
294.15	344.80	329.67	4.39
295.15	345.39	332.20	3.81
296.15	345.97	334.74	3.24
297.15	346.56	350.04	1.00
298.15	347.14	352.07	1.42
299.15	347.72	350.53	0.81
300.15	348.30	348.22	0.02
301.15	348.88	349.98	0.32

Table 2. Standard and experimental values of sound speed obtained from stopped-pipe procedure at different temperatures

Temp. (K)	Stand. vsound (m/s)	Expt. vsound (m/s)	% error
285.15	339.49	343.60	1.21
286.15	340.08	340.80	0.21
287.15	340.68	340.00	0.20
288.15	341.86	343.92	0.78
289.15	342.27	346.24	1.28
290.15	342.45	349.24	1.98
291.15	343.04	343.60	0.16
292.15	343.63	344.68	0.31
293.15	344.22	343.28	0.27
294.15	344.80	345.32	0.15
295.15	345.39	339.68	1.65
296.15	345.97	342.64	0.96
297.15	346.56	343.84	0.78
298.15	347.14	345.04	0.60
299.15	347.72	337.08	3.06
300.15	348.30	343.52	1.37
301.15	348.88	342.20	1.91

The obtained results of the open-pipe procedure were shown in Table 1, while those of the stopped-pipe procedure were shown in Table 2. The least and greatest % error obtained were equal to 0.02% and 8.39%, respectively, as shown in Table 1. Moreover least and greatest % error obtained were equal to 0.20% and 3.06%, respectively, as shown in in Table 2.

Conclusion

The superimposed graphs of the data obtained from frequency versus harmonic number (f-vs-n) experiments (i.e. open-pipe and stopped-pipe procedures, respectively) show straight-line curves. Therefore the relationship between frequency and harmonic number variables is linear.

The speed of sound at different room temperatures were experimentally measured and deduced with no percent error greater than 8.39%. Therefore, the speed of sound at different room temperatures had been measured with fair accuracy and precision.

It is therefore concluded that the recently developed resonance tube setup is suited for experiments and other related activities in the physics classroom. The concepts resonance, normal modes and speed of sound can be demonstrated without the need of spending much on the commercially available models.

REFERENCES

Adobe Audition version 1.5 available at www.adobe.com.

Minitab version 16.1.0.0 available at www.minitab.com.

Pasco Scientific, Inc., Economy Resonance Tube WA-9495, http://store.pasco.com

Young, Hugh D. and Roger A. Freedman. Sear and Zemansky's University Physics With Modern Physics 12th ed. San Francisco: Addison-Wesley Publishing, 2008.

Print ISSN 1656-0604
Online ISSN 2244-6532

Science and Mathematics Education

Teachers' Profile and Characteristics and Students' Achievement in Science and Mathematics in Religious of the Virgin Mary High Schools in Southern Mindanao

Sylvia Jorolan Pidor
University of the Immaculate Conception, Davao City, Philippines
Email: spidor@uic.edu.ph

ABSTRACT

The attributes that students observe in their teachers may affect their learning. This study investigated the science and math high school teachers' profile and characteristics and their students' achievements in the subjects using descriptive comparative and correlational designs. Fifty-six teachers and 2240 students from 13 Religious of the Virgin Mary (RVM) high schools in regions XI and XII in Southern Mindanao were randomly selected as subjects. Majority of the teachers were profiled as female, 25 years old or younger, with less than five years teaching experience and rare attendance or speakerships in national and international seminars; bachelor's degree graduates, many with honors, of accredited HEIs; and licensed by the Professional Regulations Commission (PRC). Overall, they manifest outstanding and very satisfactory levels of professional and personal qualities, respectively. The students' mean scores in science achievement test are satisfactory and comparable for both regions; while very satisfactory and satisfactory for region XI and XII, respectively in mathematics, exhibiting significant difference ($t = 3.91$, $p < .05$). Pearson r test revealed significant relationships between teacher professional and personal qualities with students' science and math achievements (p values < 0.05), implying that students' achievements are functions of teachers' characteristics.

KEYWORDS: Science and mathematics education, teachers' profile and characteristics, Pearson r, Religious of the Virgin Mary (RVM), Philippines

INTRODUCTION

Teachers play very significant roles in the teaching-learning process to bring about favorable change in the learners. Teachers must have full knowledge and appreciation of their different responsibilities and possess appropriate attributes to ensure benefits to the learners (Ajos, 2004). Globally, the teaching of math and science in basic education has received much attention. For instance, the Trends in International Mathematics and Science Study (TIMSS) has been conducting periodic international assessments on the subjects with the goal of helping countries make informed decisions about how to improve teaching and learning in mathematics and science. With its curricular focus, TIMSS has been utilized by researchers across countries in evaluating achievement goals and standards in an international context (TIMSS, 2015).

In the Philippines, the Department of Education (DepEd) observed a crisis in the Philippine education noting in the 2004 High School Readiness Test that only 0.64% of a million examinees scored 75% or better. Though there was an increase in the equity and participation rates in education, quality problems were revealed such as a dismal competency in the science and math areas (Ho, 2004). This is supported by a study that showed that mathematics and science performance of Filipino children between nine and 14 years old were two standard deviations below the international mean (Gonzales, 2004). Additionally, the Philippines ranked third to the last or 37th out of 39 countries in the TIMMS assessment test mathematics, while fifth from the bottom in science (TIMMS, 2003). In the nationwide achievement test in Mathematics, Science and English, Region XI specifically Davao City placed 15th out of 17 regions in the country.

Individual schools have societal and moral responsibility to afford to their students the best possible education. The Religious of the Virgin Mary (RVM) congregation, in their evangelical mission through education, has founded educational institutions across the country since its inception at the start of 1900s including 13 basic education schools in regions XI and XII in Southern Mindanao. These RVM schools are run and managed by the congregation sisters with their founder Mother Ignacia del Espiritu Santo's authentic Marian devotion as model. Amidst socio-cultural challenges, the schools have grown, and in response to the national science and math education adversities, posed to assess existing teaching-learning conditions.

This study is anchored on the theory of Ausubel (2005 Archives), who viewed situational variables as factors present in the learning condition and eventually influence learning. From the standpoint of the theory, the factors

that may influence the academic performance of the learners are not only those brought about by students themselves but also those which are related to teachers as the instructional designers, who can best arrange the conditions that facilitate learning for the students. Learning must be holistic. As Darling-Hammond (1995) observed, training of the mind of the students is needed for them to become reflective and critical minded. This can be done through teachers' creativity in making students learn by using all their faculties rather than by merely memorizing facts, as well as in facilitating learning that involves the development of knowledge, skills, and desirable attitudes and values that are important not only for the students' success in the academe but also for their exemplar performance beyond the school.

Presented in Figure 1 is the conceptual framework of the study showing the teacher's profile and characteristics as independent variables that are thought to affect student's achievement in science and mathematics as the dependent variable. The teacher's professional and personal qualities are the factors considered under teacher characteristics that could influence students' academic performance. Under teacher's profile, the influence of educational qualification, teaching experience, age, gender, number of times attending a seminar, number of times hired as a resource person, type of school graduated, licensure exams passed, and graduating with honors in bachelor's degree to students' achievements are considered.

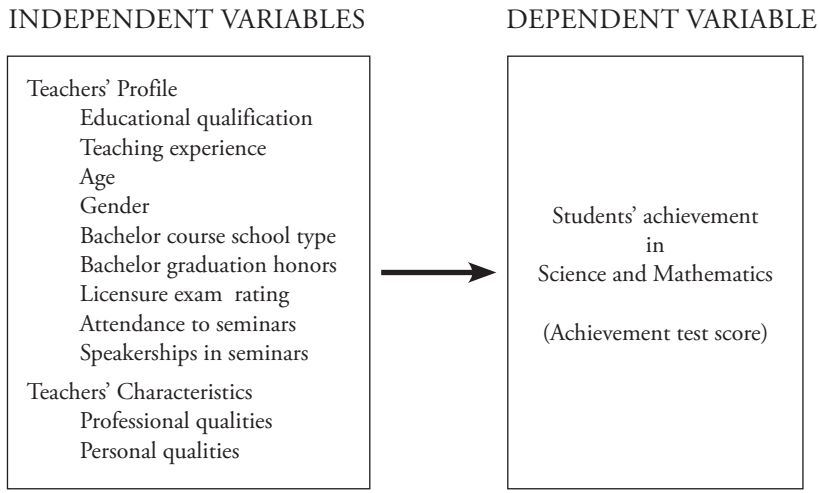

Figure 1. Conceptual framework of the study

Study Objectives. This study sought to test the null hypotheses that there are 1) no significant difference in the students' science and math achievement when they are grouped according to region, and 2) no significant relationship between RVM high school teachers' characteristics and their students' achievement in science and mathematics. Specifically, it aimed to determine the profile and characteristics of science and math teachers in Southern Mindanao RVM high schools; their students' performance in science and mathematics achievement tests; and which teacher characteristics and profile are determinants of students' achievement in science and math. The findings of this study would be utilized for the improvement of an intervention plan or a faculty development program.

METHOD

Descriptive comparative and correlational designs were utilized to investigate the differences and relationships between teachers' characteristics and students' achievement in all 13 RVM high schools in regions XI and XII in Southern Mindanao. The respondents of the study are 56 teachers and 2,240 students (table 1). This study sample was chosen by proportional random sampling based on Slovin's formula to ensure proper representation of the population.

Table 1. Distribution of study respondents

School	Location, Region	Number of Respondents			
		Teachers		Students	
		Science	Math	Science	Math
University of the Immaculate Conception	Davao City, XI	4	3	160	120
Our Lady of Fatima Academy	Davao City, XI	3	3	120	120
St. Mary's Academy	Digos City, XI	2	3	80	120
St. Mary's Academy	Sta. Cruz, XI	1	1	40	40
St. Mary's College	Tagum City, XI	3	3	120	120
St. Mary's Academy	Baganga, Davao Oriental, XI	1	1	40	40
St. Mary's Academy	Karaga, Davao Oriental, XI	1	1	40	40
Holy Cross	Bansalan, Davao del Sur, XI	1	1	40	40
Notre Dame	Makilala, North Cotabato, XII	1	1	40	40
St.Mary's Academy	Midsayap, North Cotabato, XII	4	3	160	120
St.Mary's Academy	Kidapawan, North Cotabato, XII	2	2	80	80
Notre Dame-RVM College	Cotabato City, XII	4	3	160	120
Pilar College	Zamboanga, XII	2	2	80	80
	Subtotal	29	27	1160	1080
	TOTAL		56		2240

The data were gathered using a researcher-made and expert-validated questionnaire divided into two parts. Part 1 was designed to elicit data on the teacher's profile while Part 2 on the teacher's professional and personal characteristics. The data on the achievement in both science and mathematics of the students were also taken. Permission to conduct the study was formally sought from the RVM schools superintendent in Mindanao. The researcher personally administered the questionnaire to some secondary schools in Southern Mindanao, while the rest were distributed through a courier. Analysis and interpretation of the data was done using descriptive and inferential statistics, specifically T-test to determine differences and Pearson Product Moment Correlation to determine relationships. Testing of the null hypothesis was based at .05 level of significance.

RESULTS

Teachers' profile and characteristics

The high school science and mathematics teachers in southern Mindanao RVM schools can be pictured as generally young in both age and teaching experience; graduates of accredited HEIs, many of whom with honors; geared towards earning their master's degrees; and are licensed to teach by the Professional Regulations Commission (PRC) by virtue of their passing the licensure exam for teachers (LET). Few had attended seminars or had speakership engagements (table 2). That majority of the teachers are female is understandable because for so many years, most RVM schools have been exclusively for girls.

Table 2. Profile of the RVM high school science and mathematics teachers

Aspect	Findings
Educational qualification	83.92% are Bachelordegree holder with masteral units
Teaching experience	69.64% have less than 5 years teaching experience
Age	68.02% are within 25 or below age bracket
Gender	66.07% are female
Bachelor degree school type	85.71%earned their Bachelor's degree from accredited HEIs
Bachelor degree honors	34% graduated with honors
Licensure examination	94.64% are LET passers
Attendance to seminars etc.	Average of 5, 1, 4 and 2 teachers had attended seminars at a local, district, city and regional level, respectively. One teacher from Reg. XI had attended 10 national and one international seminars
Speakerships in seminar etc.	There were 10 occasions of resource speakerships either in a local, city, or regional level seminars by certain Reg XI teachers; 6 by Reg XII teachers; One spoke at a national seminar, none at international level

In terms of the teachers' professional qualities, an overall mean of 4.51 was obtained (table 3), which can be interpreted as outstanding, demonstrating their high level of understanding the learners and the teaching profession and principles, which trickle down to their having very high mastery of their subjects.

Table 3. Teachers' professional qualities

Aspect	Mean Score	Qualitative description
Mastery of the subject	4.71	Outstanding
Understanding the learner	4.22	Very Satisfactory
Understanding of teaching principles	4.30	Very Satisfactory
Understanding and appreciation of the teaching profession	4.79	Outstanding
Overall	4.51	Outstanding

In terms of the teachers' personal qualities, an overall mean of 3.9 was obtained (table 4), which has an equivalent description of very satisfactory. This means that they manifest a very satisfactory evidence of sound physical health; emotional, social, and intellectual maturity; credibility and integrity, as well as creativity.

Table 4. Teachers' personal qualities

Aspect	Mean Score	Qualitative description
Teacher Personality	3.82	Very Satisfactory
Instructional Leadership	3.79	Very Satisfactory
Creativity	4.08	Very Satisfactory
Overall	3.90	Very Satisfactory

Students' achievement in Science and Mathematics

The mean scores in science achievement test of students from regions XI and XII are satisfactory, 83.58 and 83.20 respectively; these values are close enough and the difference is not significant ($t = 0.84$, $p = .53$) as revealed by t-test (table 5). This implies that the RVM science students in both regions XI and XII have equal or comparable achievement in the science subject. On the other hand, their mean scores in the math achievement test, 85.52 and 83.24 respectively for region XI and XII, are revealed significantly different by t-test ($t = 3.91$, $p <$

.05, table 5).This implies that the RVM school students from region XI are more competent in mathematics than those from region XII.

Table 5. Students' achievement in science and mathematics and their significant difference based on region

Region	Mean Score	Lowest Score	Highest Score	Computed t-value	p-value
Science					
Reg XI	83.58 (Satisfactory)	75 (Poor)	95 (Outstanding)		
Reg XII	83.20 (Satisfactory)	75 (Poor)	97 (Outstanding)	0.841	.526
Mathematics					
Reg XI	85.52 (Very Satisfactory)	75 (Poor)	95 (Outstanding)		
Reg XII	83.24 (Satisfactory)	75 (Poor)	98 (Outstanding)	3.913	.000

Test of significant relationship between teacher characteristics and student achievement

Table 6 presents the results of the Pearson r correlational test between the teachers' characteristics and their students' achievement in science and mathematics. Between the teachers' professional qualities and students' science achievement, a significant moderate to substantial relationship exists ($r = 0.642$, $p = .004$), implying that the higher the teachers manifest professional qualities, the better their students perform in science. Also, between the teachers' personal qualities and students' science achievement, a significant moderate to substantial relationship exists ($r = 0.638$, $p = .006$), implying that teachers' personal qualities affect students' science achievement. Likewise, significant high or marked relationships exist between the students' math achievement and their teachers' professional ($r = 0.778$, $p < .05$) and personal qualities ($r = 0.752$, $p < .05$). These imply that the teachers' professional and personal demeanors could significantly affect their students' performance in mathematics.

Table 6. Correlation of teacher professional and personal qualities to their students' science and mathematics achievement

Variables correlated	Computed Pearson r	p-value	Interpretation
Teachers' professional qualities and Students' science achievement	0.642	.004	Moderate or Substantial Relationship
Teachers' personal qualities and Students' science achievement	0.638	.006	Moderate or Substantial Relationship
Teachers' professional qualities and Students' math achievement	0.778	.000	High or Marked Relationship
Teachers' personal qualities and Students' math achievement	0.752	.000	High or Marked Relationship

DISCUSSION

The profile of the science and math teachers in the RVM high schools in Southern Mindanao could reflect their tendency to not stay long in service. A certain study on teacher experience (Glenn, 2002) highlights that the stability of a school's faculty as measured by the teacher's years of experience is important to the quality of education provided by the school as it impacts students' achievement. Teachers with fewer than three years of teaching experience tend to be less effective than more experienced teachers. The same study concludes that teachers with more teaching experience and higher qualification are able to provide better quality instruction that result in higher learning and lead to higher student achievement.

Among the aspects under teacher profile, seminar attendance and speakerships turned out relatively low, which prompts for a more aggressive faculty development program. As Kast and Rosenzweigh (1974) emphasized as elements of a teaching profession, a teacher must be a member of numerous organizations for updating or sharing of recent developments. Attendance to relevant conferences means undertaking discussions on new studies and techniques on their field. Teachers exposed to different conferences get the privilege to expand knowledge on their area of specialization hence gain more confidence.

The overall outstanding professional qualities of the teacher respondents

reflect their understanding of the basic principles of human development and of their students' differences in levels of maturity; possession of needed skills and techniques in teaching implementation and working with their students in mutual satisfaction within ethical and professional context; and practice of principles of effective selection, preparation and utilization of instructional materials, provision of critical thinking situations, creativity, and inter-communications. Unarguably, the simplest of the routine responsibilities of a teacher entails unmatching challenges. As Palma (1992) stressed, an effective teacher employs varied strategies that will set the mood for classroom activities that are challenging enough for different kinds of students, for them to be encouraged to actively participate, so that their thinking is enhanced and learning takes place.

Likewise, the overall very satisfactory personal qualities of the teachers are a reflection of their wholesome personality. This encompasses their competence in leading the faulty to render best performance, promoting peace and showing interest in apparent disorder, contradiction, and imbalance as challenges; understanding one's feelings and emotions; being flexible and decisive for the benefit of the organization; and producing something innovative through imaginative skills. As Acero (2000) argues, effective teachers are guided by the spirit of service to benefit others, confirming the observation of Lardizabal (1999) that teaching is one of the most important professions from the standpoint of human welfare.

There are significant relationships between teachers' professional qualities and students' science and math achievements. This is consistent with the results of a similar study which has indicated that the elements of secondary science teacher are significant school-based variables related to science students' achievement, adding that an effective science teacher has a strong science background and a keen sense of professional identity (Yuan, 1990). Moreover, Glenn (2002) reveals that there is evidence that the formal qualification and experience of both lower and upper secondary science teachers are positively correlated with the achievement of their students especially in developing countries. He further stresses that teacher characteristics and student-teacher interactions are important determinants of student coursework mastery.

In the same way, there are significant relationships between teachers' personal qualities and their students' science and mathematics achievements. This finding is supported by the study of Shuan (1990), which presented that teachers who are considered to be effective are humane in the fullest sense and so effective learning is enhanced. Shuan adds, setting the right environment enhances more students' participation hence greater degree of students' achievement. Further,

Blesser (1985) posits that teachers who are knowledgeable about their subjects of specialization can motivate and have positive influence in students' achievement. In this study it was shown that teacher engagement was shown to be a statistically supported construct, and was predictive of student achievement and motivation.

The findings of this study were used as basis of an intervention plan or a faculty development program by the participating schools. As an offshoot, most of these schools now hold PAASCU status and are recognized leaders in their districts or cities. Foremost are the University of the Immaculate Conception-Davao City and Pillar College-Zamboanga, which both enjoy level III PAASCU Accreditation. On the other hand, Notre Dame-Makilala and Saint Mary's College-Tagum City both hold PAASCU Level II Accreditation while Our Lady of Fatima-Davao City has a candidate status.

REFERENCES

Abad, F. (2004). Building Literacy: A Collective Responsibility." The Philippine Journa; of Education

Acero, V. (2000). Principles and Strategies of Teaching. Rex Printing Company, Quezon City

Ajos, R. (2004). "The Teacher and the Nation." The Modern Teacher

Arado, S. Tersita, RVM. "Needs Assessment of Teachers of RVM Tertiary Schools in the Philippines. USC, Cebu City, 1999

Ausubel, D. (2000). Acquisition and retention of Knowledge: A Cognitive View . Dodrecht Kluwer

Calderon, S. (1998). Interdependence of Learners and Teachers. McMIllan NY

Day,C. (1999). Developing Teachers: The Challenge of Lifelong Learning, Biddles Ltd., Great Britain

Darling-Hammond. (1995). "Teacher Characteristics. Student Demographics and Student Achievement". California

DepEd Report. 2005. From www.deped.gov.ph/updates. Retrieved July 14, 2007.

Elliott, S. (1996). Educational psychology: Effective Teaching: A Skills Approach. Books Atbp. Publishing House Corp., Mandaluyong City

Gaff and Justice. (1978). Teachers and Teaching. Brown and Benchmark Publishers, USA

Glenn, R. (2002). " Admirable Teaching Traits " Texas.

Gonzales, A., FSC. (2004) "Educational Cross Currents." The Philippine Journal of Education

Good, T. and Brophy, J. (2003). Looking in Classrooms. Pearson Education, Inc, USA

Ho, L. (2004). "Quest for Quality in Teacher Education" The Philipine Journal of Education

Kast, T. and Rosengweigh, W. (1974). Journal of Education

Matutino, Nida. "The Relationship Between the Acdemic Performance in Science and the Science Achievement Test results of Grade Six Pupils of UIC", UIC, Davao City

Palma, John U. (1992). Students and Their Learning . Manila National Bookstore

Quisumbing, L. (2003). "Citizenship Education for Better World: A Holistic Approach." The Philippine Journal of Education

Salandanan, G. (2001). Teacher Education Journal. Katha Publishing Co., Inc., Quezon City

Sevilla P. (1993). Gauges of Learning . Manila Rex Bookstore

Shuan, Y. (1990). "Teacher Characteristics and Student Success". Dallas

Trends in International Math and Science Study. (TIMSS, 2015). Retrieved July 11, 2015 from http://nces.ed.gov/TIMSS/ and http://timss2015.org/timss-2015/

Torralba, A. (1988). The Joys of Teaching. Universal – Aperture, Makati City

Travers, P. and Rebore, R. (1995). Foundations of Education. A Simon and Schuster Co., Massachusetts

Ware, S. (1995). "Secondarychool Service in Developing Countries: Status and Issues". Washington USA

Woods, P. (1990). Teacher Skills and Strategies. The Falmer Press, London

Print ISSN 1656-0604
Online ISSN 2244-6532

The Divergent Journey of Philippine Science High School Scholars: Farewell to STEM Courses

Rochelle T. Papasin
Philippine Science High School – Southern Mindanao Campus
Davao City, Philippines
Email: rtpapasin@gmail.com

ABSTRACT

While the Philippine Science High School (PSHS) graduates are required to pursue science, technology, engineering, and math (STEM) courses in college, some end up unable to complete a STEM course. The participants were interviewed electronically to describe events that led them to other career paths. The responses indicate that all the participants initially enrolled in a STEM course with the intentions to comply with their PSHS scholarship agreements. Three themes emerged from the responses. The first is the lure of other interests. Sometime in their second year in college, some participants began to consider other interests. The second theme that emerged was getting low grades. The earlier advantage of strong pre-college training offered by the PSHS was not able to sustain them in more advanced courses. The third theme was on socio-economic factors. The low grades led to termination of college scholarships in STEM. With these, financial challenges came and some participants opted for less expensive college courses. Despite the non-completion of a STEM course, all participants agreed that the strong training in sciences, technology and mathematics remain relevant in their chosen fields.

KEYWORDS: PSHS graduates, scholarship agreement, non-completion of STEM courses

INTRODUCTION

The Philippine Science High School (PSHS) was created to build a manpower base of science and technology professionals. Students with high aptitude in science who qualify into the program are offered a four-year secondary school education with free tuition, use of available textbooks, and a monthly allowance commensurate to the socio-economic standing of the family. In return, the scholars are expected to pursue a science, technology, engineering, or math (STEM) degree in order to contribute to the science and technology workforce. The Philippines sorely lacks technical people so that industrial and technological development is hampered. The PSHS selects students with high aptitude in science and trains them in a science-enriched curriculum to prepare them for STEM courses at the university level.

The impact of STEM workforce is notable everywhere. The demand for more scientists, engineers, technologists and mathematicians is increasing worldwide. The United Kingdom notes that it needs 100,000 STEM graduates annually and that STEM graduates account for only 22% of its college graduates, a dismal comparison to China which awards 41% of its degrees to engineering graduates (Science Learning Centre, 2013). Henderson (2012) reported that more than half of Japanese students graduate from STEM courses. The Philippines lags behind with only half the UNESCO recommended number of 380 scientists and engineers per million population in 2009 (Compendium of Science and Technology Statistics, DOST 2012). In comparison, Japan had 5561 scientists and engineers and 864 technicians per million population in 1990-1997 (Tapang, 2007).

The Philippines graduates the lowest percentage of scientists and engineers worldwide. Notwithstanding the country's international position, the PSHS continues to offer scholarships to Grade 6 pupils for a secondary course with emphasis on science. Selection of PSHS scholars is rigorous and qualified applicants must pass the National Competitive Examination (NCE). They must show aptitude in science while in Grade 6 and must have a grade no lower than 85 in science and mathematics. Each year, PSHS selects only a limited number of scholars: 240 for the Main Campus in Quezon City and 90 in each of the 11 regional campuses. Successful applicants are entitled to free tuition, free loan of available textbooks and a monthly allowance depending on the family's socio-economic indicators. The PSHS Scholarship Agreement has a provision that binds the scholar to pursue a science, engineering or related course at the college level. Failure to comply with this requirement makes the scholar and his/her

parents liable to pay back the money value of the scholarship enjoyed (About PSHS, 2013).

As of 2013, PSHS National Alumni Association boasted a membership of 15,000. The impressive list of alumni achievers are from STEM disciplines. They are found in the academe, in medicine, in engineering and information technology, in public service, in business and finance, in government, in the military, in social service and even in arts and humanities as writers, film makers and artists (Notable PSHS Alumni, 2010).

The first regional PSHS campus established outside of Metro Manila in 1988 was the then PSHS-Mindanao Campus (now PSHS-Southern Mindanao Campus), in Tugbok, Davao City. It produced its first graduates of 52 students in 1992 (PSHS-SMC Annual Report, 2010). In the last ten years, PSHS-SMC has actively tracked its scholars. While many have been tracked, many have not provided data on their whereabouts. Informal channels of information reveal that some of the scholars refuse to reveal the fact that they have pursued degrees and careers away from STEM.

It is important for the government and policy makers to have the information whether or not PSHS is making the desired contribution to the S & T manpower needs of the nation. This study was undertaken to describe the journeys of PSHS-SMC graduates away from science, technology, engineering or mathematics (STEM) courses as required by the terms of their scholarship.

Study Objectives. The purpose of this phenomenological study is to discover the reasons of PSHS-SMC graduates in pursuing non-STEM courses. Specifically, it explored what insights of non-STEM college graduates they could share to current and future scholars of PSHS-SMC. The stories of five PSHS-SMC alumni who have not completed STEM course in college were the focus of this investigation.

The Road to STEM Careers

With the projected shortage in STEM professionals by 2020, Microsoft conducted a survey intended to gain insight on how students find the inspiration to pursue STEM careers. Eighty percent of the students indicated that the decision to pursue STEM courses in college was made in middle school. More than half revealed that a teacher or a class they took inspired them to pursue STEM. Still, 20% of the students felt that their K-12 education did not prepare them well for STEM courses. Those pursuing STEM in college admitted that the motivation

was not derived from parental influence but by the desire to pursue a career with good job potential and a good salary (Microsoft News Center, 2011).

Hossain and Robinson (2012) reported that most US parents agree that choice of a career must consider both interest/ability and the job market. However, many parents also believe that STEM majors require financial investment and demand much work. This sentiment is confirmed by both students and teachers. Success in STEM careers requires preparation as early as middle school and sustained through college and graduate school by a supportive academic environment.

Engberg and Wolniak (2013) studied the high school to college pathway towards a STEM career. They emphasized the importance of STEM exposure as early as high school towards choosing a STEM major in college. At the post secondary level, extracurricular activities provide a negative impact on students majoring in STEM. It was recommended that college STEM majors be provided with support in academic planning and study skills to be able to balance their learning opportunities. For students who enrolled in STEM majors as college freshmen, 18% ended up completing a non-STEM major. The strongest predictor to STEM retention is prior academic preparation (Hurtado, Eagan & Chang, 2010).

The path to a STEM career has been described as a "leaky pipeline" (Clark Blickenstaff, 2005). In this context, people enter the STEM profession through a linear mode beginning from childhood through high school, college, and graduate school. Because people leave STEM careers along the way, this pipeline is thus described as "leaky". Some students drop out of the pipeline due to limited opportunities such as financial capabilities, poor literacy skills, and lack of prerequisite knowledge (Lyon, Jafri & St. Louis, 2012).

Cannady, Greenwald & Harris (2014) object to the pipeline metaphor as it fails to consider the complexity of factors that play a role in career decisions. They offer a more flexible "pathways metaphor" which provides more inlets and outlets towards STEM careers in recognition of the constraints and opportunities faced by each individual. They pointed out that some people actually earn a bachelor's degree in STEM but do not enter a STEM career. For these people, interest or the lack of it is a key factor in their career choice. Cannady and colleagues pointed out that all is not lost when a STEM-trained individual drops out of the STEM pipeline as some careers still employ the relevant knowledge and skills gained while undergoing STEM training. Resiliency in STEM careers is mediated by many socio-cultural factors. While academic abilities are important, equally relevant is the ability to navigate through the academic world. Career decisions can also be shaped by life events particularly those that happen in the family.

METHOD

The study employed a qualitative research design using a questionnaire with open-ended questions to elicit rich descriptions of the lived experiences of selected PSHS alumni. As Creswell (2012) pointed, use of open-ended questions allowed opportunities for the participants to express significant statements and structural descriptions of their experiences. Five PSHS-SMC graduates (three male and two female) were purposively selected as participants of this study. Again, Creswell (1998) stated that five participants can comprise a phenomenological study. Three of the participants are based in Manila and two are based in Davao City.

Data Collection and Analysis. PSHS-SMC alumni who met the criteria of completing non-STEM courses were sent electronic messages asking their participation. Those who signified their willingness were given sufficient time to return the questionnaire. Electronic responses were collected and used in this study. The written responses were read several times to get an understanding of the messages conveyed by the participants. From the responses of the participants, significant phrases and sentences pertaining to their journeys away from STEM careers were identified. Meanings were formulated from these phrases and statements. The meanings were clustered into themes to allow common themes to emerge. The results were integrated into descriptions of the phenomenon.

Role of the Researcher. The researcher was the interviewer. Since the interview was conducted electronically, the researcher was also the note-taker. Past information on the reasons for choosing careers away from STEM were not available to the researcher so that an understanding of this phenomenon is based on the responses elicited and the stories the PSHS alumni have willingly shared. The absence of prior knowledge allows the researcher to approach the phenomenon with openness. Despite the researcher's position as a parent to PSHS-SMC scholars and a senior teacher in PSHS-SMC, the researcher observed Moustakas' (1994) epoche in setting aside own predispositions, to draw an unmitigated picture of the compelling reasons of PSHS-SMC alumni for veering away from the required STEM courses.

Trustworthiness of the Study. Credibility of the methodology was attained through verification and validation. The verification standard was attained through literature search and adherence to the methods of phenomenological research. Validity was achieved through member checks by the participants. Transferability was addressed by using thick descriptions of the experiences of the participants. Dependability was achieved by providing details of the processes employed in the design and implementation of the study. Confirmability was

attained by triangulation. This involved checking the online profiles of the participants particularly through their accounts in Facebook, LinkedIn and Twitter when available.

Ethical Considerations. The participants were invited to take part in this study by informing them what the objectives of the study were. They were assured of the non-disclosure of their identities in order to protect them from any liabilities arising from their choice of careers. Their identities were hidden in the code names Helium, Iridium, Krypton, Neon and Palladium, and only the researcher knows who they stand for. Their participation was voluntary and they signified their informed consent by returning the completed questionnaire to the researcher. The responses were acknowledged upon receipt. The results of the study were sent back to them for their information.

RESULTS AND DISCUSSION

A PSHS-SMC graduate has been schooled and prepped for a STEM career. This is clearly articulated in the PSHS website "When they graduate, the scholars are expected to pursue degrees in Science and Technology at various colleges and universities both here and abroad" (About the PSHS System, 2013). The initial step toward or away from a STEM career begins with a university level course.

Pure Intentions

Having graduated from high school at the tender age of 16, the PSHS-SMC graduate has to decide on a life-long career. Iridium, so named for being youthful and of sunny disposition, was dissuaded by her parents to pursue a STEM course and instead take up the then very popular BS Nursing because it held promises of employment overseas which translates to higher income. However, the intent to study a STEM course remained and in fact Iridium is currently enrolled in a second collegiate course, this time along the STEM track. The other participants initially took up a STEM course in college in an attempt to comply with the scholarship requirements.

The start of their journey begins. According to Helium, named after the sun or the source of light, *"At that point, I was not sure yet what I really want to pursue. Since I also passed and made it to the DOST Scholarship Program, I took B.S. ECE to be practical".* Palladium, named after the Goddess of Wisdom shared, "I just

chose the course because it was required and taken on full scholarship". Krypton, he who is a heavy weight, with advanced degree, and works in unearthing the hidden said that he had *"no life plans"*.

These stories highlight the fact that PSHS-SMC graduate leave high school with a vague vision of their future.

Divergent Journey: The Road Not Taken

Sometime in college, the participants realized that a STEM course was not the one for them. Hossain & Robinson (2012) reported that while they recognize the value of STEM as a career, many US parents feel that the academic preparation requires much hardwork. A sentiment along this line was expressed by Krypton,

> *"I was too young to know what I really wanted to do in life. Filipino culture does not really appreciate science and all its practical applications in life. Also, STEM degrees can be elitist, which can be a major reason for people to be disinterested".*

While some of the participants enjoyed scholarships in STEM courses, their interest in these courses dwindled. Perhaps the decision came with the age of maturity as the firm decisions came around the age of 18. Perhaps the advantage of the advanced training has faded by then. According to Helium,

> *"Academic pressure was so high that most of PSHS graduates tend to take it easy in their first two years in college. PSHS should also create a program to prepare its graduates emotionally for these moments. A balance high school life is necessary to improve the students EQ (and not just the students' IQ)".*

What appears to be lacking in the picture is the lack of continuing support. Like many Filipino college students, the PSHS scholars navigate through college on their own. While the capacity to handle the challenges of STEM courses have been built, there appears a gap in the high school-college transition and this peaks around the end of the second year in college. Lyon, Jafri & St. Louis (2012) calls this gap the lack of "continuity". Continuity means more than a formal exposure to STEM. There has to be avenues for internships and youth camps. Continuity allows students to build relationships with STEM professionals in the academe

and in the industry. These relationships allow them to build connections and find meaning in their academic endeavors.

The second year in college is also critical as the participants encountered two major challenges around this period: low or failing grades and financial difficulties. Decisions had to be made.

Some decisions were practical. These came from the male participants.

> *"Due to low grades, I had to shift courses… I just selected the easiest one just to have a college degree" (Krypton).*
>
> *"Financial difficulties affected my studies. I shifted… and finished the course"(Helium).*
>
> *"I believe it was a combination of family issues during the financial crisis…. I actually started… but shifted… to finish my studies on time"* (Neon).

Cannady, Greenwald & Harris (2014) recognized the role of socio-cultural factors in choosing careers. With STEM careers requiring laboratory work, the matriculation expenses are higher than other courses. This is apparent in the experiences of Helium and Neon when they opted to shift to other courses. The path to a STEM degree is not leak-proof. As reported by Hurtado, Eagan & Chang (2010) , 18% of those who enrolled in STEM courses as freshmen end up completing a non-STEM degree.

Some decisions were inspired. These were from the females:

> *"I felt I was just complying with requirements and my heart was not in it. In the …University, we have to take Philosophy as a core subject. I discovered that it made me come alive and I joined a majors class" (Palladium).*
>
> *"I was used to subjects concerning science and mathematics as I was also inclined to these subjects. Nonetheless, I was thankful for having taken up …..because back then, I didn't have good communication and interpersonal skills. It was hard for me to talk to people" (Iridium).*

While the participants showed aptitude in science, they had natural tendencies for other disciplines. They went through the motions but the heart was not there. This was expressed by the articulate Palladium who said, *"I was not interested and felt I had no natural aptitude for it. I did well when I applied*

myself but I had no authentic inner drive for it. I did not care much if I failed or got low grades. I would always get derailed by other interests and pursuits".

Gifted students have talents in many directions. They have varied interests. College provides many opportunities to pursue these interests. Nonetheless, departures from the STEM track may be abated with support and guidance. Engberg & Wolniak (2013) recognized that extracurricular activities provide a negative impact on students pursuing STEM majors. It was recommended that college STEM majors be provided with support in academic planning to be able to balance their learning opportunities.

Time to be Happy

In their first year of stay in the PSHS-SMC, these participants were schooled under a lively Science Teacher who started her classes with an upbeat song that has stayed with them all these years and it goes, "The time to be happy is now and the place to be happy is here, and the way to be happy is to make others happy and to have a little heaven down here."

Those who are more mature, currently in their 30's, are proud of their achievements and express very high level of satisfaction with their present careers away from STEM. Here are their stories:

> *"I currently own and manage a graphic design/advertising firm"* (Neon, so named after the glitter of advertising lights).

> *"I have a thriving business and I also teach (in the university). I actually teach Philosophy of Science because apparently I am one of the few faculty who can do and understand high science from which philosophizing jumps off. I am in the task force of the Dean to create the curriculum on Life, Science, and Technology. I just finished helping craft a Philosophy of Science course for a PhD program".* (Palladium)

> *"I am a Forensic Anthropologist and Assistant Professor at the University.… I am consulted.… whenever there are cases that involve decomposing, burnt, mutilated or skeletalized human remains. I also teach undergraduate classes. I am satisfied, enthusiastic and enjoying"* (Krypton).

Those in their 20's , who are still beginning their careers are satisfied but less so,

> *"As of the moment, I am back to school, taking up BS Environmental Science… I am happy and the program I got in is very exciting"* (Iridium).

> *"I am now working …. in a telecommunications company. I am also taking up my Masters in Business Administration in one of the top universities in the country… I am still on my way working for that career enhancement"* (Helium).

Cannady, Greenwald & Harris (2014) agree that STEM trained individuals are still able to employ their skills and knowledge in other career choices. They opined that the graduation is not the best "gatekeeper" for a STEM career. A more flexible assessment should allow for "inlets" and "outlets" towards STEM careers in recognition of the constraints and opportunities faced by each individual.

Away from a STEM career, these individuals have become productive members of our society. Their scientific skills have stayed with them and they have found their purpose in life.

Lessons Learned

The best lessons are eventually applied. The participants all agreed that at PSHS-SMC, they learned the importance of science. Years after high school and pursuing fulfilling careers, the participants live these beliefs:

> *"Science is cool. Science can improve people's lives. Science can be a tool to do good"* (Krypton).

> *"I believe that having a strong foundation in the maths and sciences is a great way to train minds of citizens who will positively and concretely contribute to the country. There really is something special about our training that gives us an edge over the others"* (Palladium).

> *"A creative mind partnered with the scientific method can lead to solutions"* (Neon).

While strong in the sciences, PSHS education has also produced these participants with strong values. They believe in integrity. They believe in excellence and continuous improvement which is captured in the essence of Kaizen. The PSHS training have not failed to imbue the participants with a patriotic orientation. Helium remembers from his teachers, *"With great talent/ power, comes great responsibility"* and *"That as a Pisay Scholar, we should also learn to give back to the community/society"*

IMPLICATIONS AND OUTCOMES

To answer the central question on the compelling reasons the participants diverged from STEM courses, the theme of the responses follow the pattern which begins with a lack of interest or a lack or purpose in life. Thus, a year or two into college, the participants encountered failing grades which in turn led to financial difficulties as they lost the scholarships they were then enjoying. Some soul-searching took place that led them to discover their hidden interests or talents.

Should PSHS continue to require its graduates to pursue a STEM course? Only one agreed to this. Here is what the other participants say:

> *"No, because at a young age we do not always know what we truly want to do for the rest of our lives"* (Palladium)

> *"No, I think it's worthy to remind everyone that some Palanca award winning creative writers are from Pisay (PSHS) . Pisay people excel even in the arts"* (Krypton).

> *"No, I think it will stifle a person's growth. It is because sometimes, a state of life, a decision, or a solution that was true for a previous situation or for a certain period in a person's life doesn't really apply to a circumstance that is in the here and now. Life is a continuous discernment process"* (Iridium).

> *"I believe that PSHS should continue to bind its graduates to STEM careers BUT has to learn to be more flexible based on the capacities and goals of their students…. Although I do understand that what I finished was not STEM-based, I do appreciate the STEM training I had which lead to a more productive career/business for me, since almost everything*

> *we do in this day and age all require STEM know-how. On a personal note, I think it is also good to have STEM graduates who actually become successful entrepreneurs who employ people and contribute to the economy of the country"* (Neon).

Repurpose is a term to indicate use in another format. It has currently found a politically-correct meaning among environmentalists wherein an object is neither recycled nor reused but repurposed. Instead of requiring the pursuit of a STEM career, the PSHS can encourage its graduates to do so. Palladium suggested, *"Perhaps, an incentive can be given to those who pursue STEM careers but not a penalty for those who don't".*

This study has resulted to an elucidation of the reasons for PSHS-SMC graduates to diverge from the recommended path towards STEM careers. Largely because they had little inherent interest in STEM and for lack of support and guidance, they met obstacles and influences and were persuaded to travel another road. Away from STEM careers, they have found life's purpose. Yet the strong foundations of science and mathematics have remained in their lives and careers. The lessons learned from PSHS continue to live. Even away from STEM careers, PSHS remains relevant. Nearly fifty years after PSHS has been established, it is time to revisit its purpose in the development of S & T capability of the Filipino nation.

REFERENCES

About the PSHS System. (2013). Quezon City: Philippine Science High School System. http://oed.pshs.edu.ph/the-pshs-system

Cannady, M.A., Greenwald, E. & Harris, K.N. (2014). Problematizing the STEM Pipeline Metaphor: Is the STEM Pipeline Metaphor Serving Our Students and the STEM Workforce?. Science Education, 98(3), 443-460.

Carnevale, A., Smith, N. & Melton, M. (2011). STEM: Science, technology,engineering, and mathematics. Georgetown University Center on Education and the Workforce. Washington: DC. Retrieved from http://cew.georgetown.edu/STEM/

Clark Blickenstaff, J. (2005). Women and science careers: leaky pipeline or gender filter?. Gender and education, 17(4), 369-386.

Compendium of Science and Technology Statistics. (2012). Department of Science and Technology, Planning and Evaluation Service-S&T Resource Assessment and Evaluation Division (DOST, PES-STRAED).

Creswell, J.W. (2012). Qualitative inquiry and research design: Choosing among five approaches. Sage.

Creswell, J.W. (1998). Five qualitative traditions of inquiry. Qualitative inquiry and research design, 65-113.

Engberg, M. (2013). College student pathways to the STEM disciplines (Doctoral dissertation, Teachers College). Retrieved from http://ecommons.luc.edu/cgi/viewcontent.cgi?article=1020&context=education_facpubs

Henderson, J.M. (2012). Why Aren't America's Students Smart Enough to Handle Science? http://www.forbes.com/sites/jmaureenhenderson/2012/06/21/why-arent-americas-students-smart-enough-to-handle-science/

Hossain, M.M. & Robinson, M.G. (2012). How to Motivate US Students to Pursue STEM (Science, Technology, Engineering and Mathematics) Careers. Online Submission.

Hurtado, S., Eagan, K. & Chang, M. (2010 January). Degrees of success: Bachelor's degree completion rates among initial STEM majors. Higher Education Research Institute at UCLA, January.

Howard-Brown, B. & Martinez, D. (2012). Engaging Diverse Learners Through the Provision of STEM Education Opportunities. The Southeast Comprehesive Center. Austin, TX. Retrieved from http://secc.sedl.org/resources/briefs/diverse_learners_STEM/The President's

Luz, J.M. (2013). The future of Philippine education: Educating for a Philippine future. http://gpcci.org/home/wp-content/uploads/2013/07/FUTURISTICS-PRES-JML-Future-of-Philippine-Education-20130620-version3-German-Economic- Forum.pdf

Lyon, G.H., Jafri, J. & St. Louis, K. (2012). Beyond the Pipeline: STEM Pathways for Youth Development. Afterschool Matters, 16, 48-57.

Microsoft News Center. (2011, September). Microsoft Releases National Survey Findings on How to Inspire the Next Generation of Doctors, Scientists, Software Developers and Engineers. https://news.microsoft.com/2011/09/07/microsoft-releases-national-survey-findings-on-how-to-inspire-the-next-generation-of-doctors-scientists-software-developers- and-engineers.

Moustakas, C. (1994). Phenomenological research methods. London, England: Sage.

Notable PSHS Alumni. (2010). Quezon City, Metro Manila: Philippine Science High School Alumni Association. http://pshsnaa.roundtable live.org/

Panela, S. (2012, Oct. 12). Lessons in business and education: Why PHL lags in science and technology. GMA News. Retrieved from http://www.gmanetwork.com/news/story/278050/economy/business/lessons-in-business-and-education-why-phl-lags-in-science-and-technology

Pazzibugan, D. (15 Aug 2013). CHED identifies "priority courses" to fill the needs of the workforce. Philippine Daily Inquirer. Retrieved from http://newsinfo.inquirer.net/460907/ched-identifies-priority-courses-to-fill-needs-oworkforce#ixzz2bNe75s2L

PSHS-SMC. (2010). Annual Report. Davao City: Philippine Science High School. Retrieved from http://smc.pshs.edu.ph/images/AR%202010.pdf

Science Learning Center. (2013). The Future of STEM Education. Retrieved from https://www.sciencelearningcentres.org.uk/news/34108

Tapang, G. (2007). Science and Technology Education for Whom? Advocates of Science and Technology for the People (AGHAM Party List). Retrieved from http://www.agham.org/cms/content/science-and-technology-education-whom

World Bank. (2013). Engineering and Science Education Project. Retrieved from http://www.worldbank.org/projects/P004591/engineering-science-education-project?lang=en

Print ISSN 1656-0604
Online ISSN 2244-6532

Students' Constructed Knowledge in General Inorganic Chemistry: An Analysis Using a Two-Tier Diagnostic Instrument

Edna T. Salva
University of the Immaculate Conception
Davao City, Philippines
Email: esalva@uic.edu.ph

ABSTRACT

An analysis of students' constructed knowledge in General Inorganic Chemistry was conductedusing the developed and validated two-tier chemistry diagnostic instrument (TTCDI). The diagnosis focused on the learning domains: properties, behavior and changes of matter, atomic structure and periodicity, and chemical bonds. The panel of experts validated the face and content validity of the TTCDI draft composed of 25 first-tiers and 25 second-tiers multiple choice items. It was tried-out to 521 purposively selected college students from the 4 tertiary educational institutions in Davao City that offer Bachelor of Science in Chemistry, Bachelor of Science in Engineering and Bachelor of Science in Pharmacy. From 50 items, it was reduced to 18 items fit for the exploratory factor analysis (EFA) which revealed that there are three factors affecting learning chemistry namely "Learner's Macroscopic View", "Learner's Particle View", and "Learner's Symbolic View". Analysis reveals that the instrument is substantially reliable (.67), composed of average difficult items (.47) with good discriminating index (.26). The constructed knowledge of the students was inadequate (below 50%) in all of the 3 topics in General Inorganic Chemistry: properties, behavior and changes of matter, atomic structure and periodicity, and chemical bonding. Through Confirmatory factor analysis (CFA) using structural equation modeling; the psychometric properties of the TTCDI were portrayed by the macroscopic, particulate, and symbolic (MPS) Learner's View Model. It best fits the 3 factors of learning affecting learning chemistry using the TTCDI. It shows that there is a strong relationship (.60) between learner's macroscopic view and symbolic view; modest relationship (.11) between learner's macroscopic view and particulate view; and also modest relationship (.28) between learner's particulate view and symbolic view.

KEYWORDS: Education, Inorganic Chemistry, two-tier diagnostic instrument, Davao City, Philippines

INTRODUCTION

The development of Chemistry education in the tertiary education is confronted with the issue on the deteriorating quality of basic education as evidently indicated in the Filipino students low performance in TIMMS 2003 and NAT 2005-2006 in Science which include chemistry-related concepts like composition of matter, physical and chemical changes of matter (Tan, 2006). Furthermore, it has been acknowledged that Filipino students tend to score lower in science items that test abstract concepts, and that this was probably due to lack of exposure to such kinds of questions (BEAM, 2008). As such, there is a need to diagnose if similar problems affect chemistry learning of college students. Hence, students' constructed knowledge in General Inorganic Chemistry necessitates an analysis using the developed and validated two-tier diagnostic chemistry instrument (TTCDI.

This study is anchored on the premise of the Model of Educational Reconstruction (MER) (Duit, Großengießer, & Kattmann, 2005) that sates having a key idea on science content is not given but has to be constructed by taking the aims of instruction and student perspectives into account. This takes into consideration the nature of learner's cognitive structure. Cognitive structure refers to the facts, concepts, propositions, theories, and raw perceptual data that the learner has, at any point in time and the manner in which it is arranged (Taber, 2002). He also emphasizes the dynamic nature of learner's construct;that teachers do not have direct access to a learner's cognitive structure; that a learner's behavior may be considered to reflect aspects of his or her cognitive structure; and that the researcher may construct models to represent cognitive structure such as the various conceptions that a learner holds, and how they appear to be inter-related. Hence, several studies were conducted focusing on the development and validation of a chemistry diagnostic instrument. Chen and Lin (2003) found that the two-tier multiple choice test provided a reliable and valid pencil-and-paper, easy-to-score instruments for science teachers and or researcher to better evaluate students' idea. Such methodology was used in this study for the development and validation of a two-tierchemistry diagnostic instrument (TTCDI) similar to that of Tan & Treagust (2002), and Beyza Karadeniz Bayrak (2013). However, this study differsfromthe aforementioned studies in terms of purpose and chemistry learning content focus.

The conceptual framework underlying the TTCDI items is patterned on MER (Duit, Großengießer & Kattmann, 2005)presented in Figure 1. Specifically, this study sought to answer the following questions: (1) What are the constructed

knowledge of students in General Inorganic Chemistry 1 based on their responses in the TTCDI; (2) What are the factors of learning affecting learning chemistry; and (3) What are the characteristics of the test items developedin the TTCDI?

It is argued that the developed and validated TTCDI is an appropriate diagnostic tool to assess students' constructed knowledge in General Inorganic Chemistry in the following learning domains: properties, behavior and changes of matter, atomic structure and periodicity and chemical bonds which is an important basis for learning plan to improve students' learning in such topics.

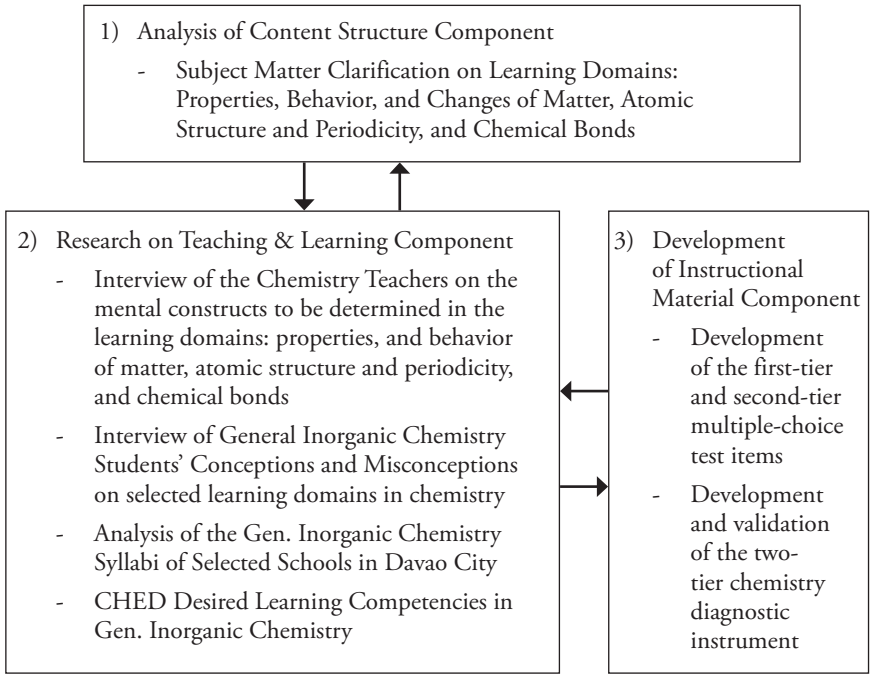

Figure1. The conceptual framework of the study

The results and conclusion generated in this study refer specifically to the sample groups involved in the study. Generalization of the findings to all college students enrolled in General Inorganic Chemistry must be considered with caution due to the nature of the sampling method applied and the limited size of the samples used in this study.

METHOD

This study used the mixed methods research design that combines quantitative and qualitative approaches to collecting, analyzing, interpreting, and reporting data (Creswell & Plano-Clark, 2007). The methods employed in the development and validation process (Figure 2) were: desk review for the content analysis of Teacher's syllabi, semi-structured interview of students and teachers of General Inorganic Chemistry for the selection of content boundaries of the 3 selected topics developed in the TTCDI, cross-sectional survey method forthe TTCDI try-out,and comparative research design using structural equation model (SEM) to examine the factor structure of the TTCDI because SEM structural models allowed testing both hypothesis and measurement models (Plitchta & Kelvin, 2013).

The participants of this study were the purposively selected college students from four colleges and universities in Davao City offering Bachelor of Science in Pharmacy, Bachelor of Science in Chemistry and Bachelor of Science in Engineering having General Inorganic Chemistry as a foundation course and consented to participate in this study. Three different groups of subjects were purposively selected for this study: 7 teachers for the semi-structured teacher's interview group; 12 students for the semi-structured student's interview group; and 521 General Inorganic Chemistry respondents for the TTCDI try-out form. Data were gathered during the AY 2012-2013 up to first semester of AY 2013-2014.

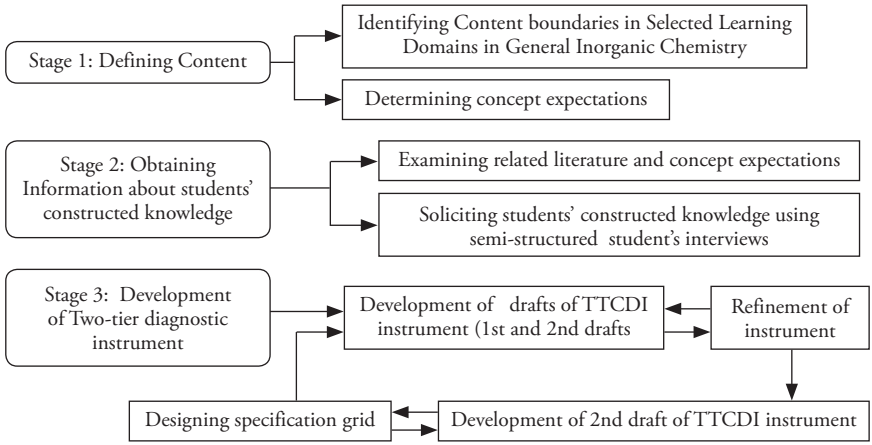

Figure2. Schematic diagram of the process of development and validation of TTCDI patterned to the process of Tan & Treagust, et al. (2002)

The following procedures were conducted: frequency counts and percentages to describe the distribution of the learning contents; internal consistency reliability analysis using Cronbach's alpha (α = 0.68) showed that the drafted TTCDI was substantially reliable to measure the constructed knowledge in chemistry. Exploratory factor analysis (EFA)and confirmatory factor analysis (CFA) were conducted to test H_{01}: There are no factors of learning affecting learning Chemistry and H_{02}: Factors of learning have no relationship.The strength of the relationships among the observed values was based on the students' responses in the TTCDI items. The sampling adequacywas established by the significant KMO and Bartlett's test values with a p-value at .000 andemploying Principal Component Analysis (PCA) using Varimax with Kaiser normalization rotation method showed rotated factor matrix of the three-factor solution. Cronbach's α was used to determinethe reliability of the TTCDI try-out formand item-total correlations of the items were usedto describe the characteristics of TTCDI itemsconsidering correlations with other variables with cut-off points of 0.20 and above (Plitchta, S. & Kelvin, E., 2013). Measures used for item analysis were: item difficulty, item discrimination, and point biserial correlation which provided useful information.

RESULTS AND DISCUSSION

Learner's Constructed Knowledge

Table 1 shows that the learnersreliable constructed knowledge using TTCDI are all below 50% in the entire targeted desired learning competenciesin General Inorganic Chemistry. The topic: atomic structure and periodicity has the greatest percentage which is 62% of not reliably constructed knowledge. As Taber (1998) has emphasized that a learner's behavior may be considered to reflect aspects of his or her cognitive structure, hence, finding suggests that those learning competencies of not highly below 50%represent the learner's constructed knowledge. This result may be attributed to the result ofteacher's syllabi content analysis which has revealed that nuclear charge and affinity explaining chemical behavior have not been evident and this may also imply that students have inadequate constructed knowledge in those topics for them to answer correctly or possibly they have only transmitted knowledge and have not really purposively constructed according to Vermette & Foote in 2001.

Factors of Chemistry Learning

Results of the EFA have revealed that there are three factors affecting students' learning in Chemistry. Factor 1has yielded pattern coefficients greater than or equal to 0.183 composed of eight (8) items. It has been labelled as "Learner's Macroscopic View" because as described by Harrison, A.G. & Treagust, D.F. (2000), macroscopic representationis constructed knowledge that describes properties of tangible and visible phenomena in the everyday experiences of learners. Factor 2 is represented by items 3, and 4. It has been labelled as "Learner's Particulate View" because this has assessed the constructed knowledge of the students on the particulate level. This finding shows that students have inadequate constructed knowledge of learning competencies on particle nature of solids, liquids and gases that supports the argument of Horton (2004) that there is ample evidence that the particle model is difficult for students to grasp. This suggests that students need reinforcement in such competencies because as Kind (2004) proposes student's ability to distinguish between elements, compounds and mixtures based on the particle model of matter may largely determine if one can continue learning chemistry. Factor 3 has been represented by 6 items and has beenlabelled as the "Learner's Symbolic View" because the items assessed students' constructed knowledge on competencies involving symbols and terms used in Chemistry and supports the finding of Cassels and Johnstone (1980) that language influences the thinking processes necessary to do any task

Table 1. Students' constructed knowledge in general inorganic chemistry using the TTCDI

Content Boundaries (Desired Learning competencies)	Reliably (α=0.723) Constructed	Not Reliably Constructed
Properties of Matter		
1. Differentiate physical properties from chemical properties		
2. Differentiate intensive and extensive properties	9,10	1,2
3. Classify matter based on their characteristic properties as: substances or mixtures, homogeneous mixture or heterogeneous mixture, element or compound, characteristic properties of compounds that are acids, bases or salts, characteristic properties of elements that are metals, non-metals or metalloids	13,14, 15,16 21,22,	7,8
Behavior of Matter		
1. Describe solids, liquids, and gases on how they fill a container		
2. Describe how matter behaves when heat is absorbed or released	3,4,	
3. Describe how change in pressure, temperature, number of particles and volume affect the behavior of solids, liquids and gases based on Kinetic Molecular Theory		5,6 45,46,47,48
4. Use Kinetic Molecular Theory to explain how the Laws of Gases: Boyle's Law, Charles' Law, Gay-Lussac's Law, Combined Gas Law and Ideal Gas Law governs the behavior of gases		49,50
Changes of Matter		
1. Describe the common physical changes of matter	17,18	
2. Differentiate physical changes from chemical changes		11,12
3. Describe the 3 laws of matter: Law of Conservation of Mass and Energy, Law of Definite Proportion and Law of Multiple Proportion govern changes of matter		19,20
Total - Properties of Matter	43%	57%

Content Boundaries (Desired Learning competencies)	Reliably (α=0.723) Constructed	Not Reliably Constructed
Atomic Structure and Periodicity		
1. Describe the three fundamental particles of an atom and their corresponding characteristic properties	23,24,25,26	
2. Describe an atom using the quantum mechanical model taking into consideration the dual nature of light		
3. Determine the electron configuration of an atom applying the principles of: Aufbau, Pauli's Exclusion and Hund's Rule of Multiplicity		27,28 29,30
4. Predict some physical and chemical properties of an element based on its electron configuration	35,36	31,32,33,34
5. Predict properties of atoms based on its Lewis structure		39,40
6. predict the periodic properties of elements such as ionization number, atomic size, ionic size, electron affinity, electro-negativity and metallic property		
Total- Atomic Structure and Periodicity	38%	62%
Chemical Bonds		
1. illustrate the formation of ionic and covalent bonds using Lewis structure		41,42
2. give the properties of compounds having ionic and covalent bonds		45,46
3. Describe the different types of intermolecular forces and relate these to the physical properties of a substance		43,44
Total – Chemical Bonds	0%	100%

Characteristics of TTCDI

The given shows that TTCDI is substantially reliable having an alpha of 0.67. This finding strongly supports the reliability of the instrument because a reliable test must be of average difficult (Raagas, 2010). The discrimination index value which is 0.26 has shown that TTCDI is good. It implies that it has distinguished between those who have learned the content and those who have not.

Table 2 presents the CFA results that have reflected the structure of the underlying students' constructed knowledge in chemistry.

Table 2. Goodness of fit measures of MPS learner's view model

Index	Criterion	Model fit value
CMIN/DF	0 << 2	1.177
P-value	> .05	.094
NFI	> .95	.912
TLI	> .95	.980
CFI	> .95	.985
GFI	> .95	.972
RMSEA	< .05	.018
Pclosed	> .05	1.000

It confirms that students' constructed knowledge have 3 factors of learning represented by TTCDI. The indices values have indicated a very good fit of the students' constructed knowledge based on their TTCDI responses because all notch within each of the acceptability criterion except NFI index, <.95 (Munro, 2013). The model of students' constructed knowledge is portrayed in Figure 3.

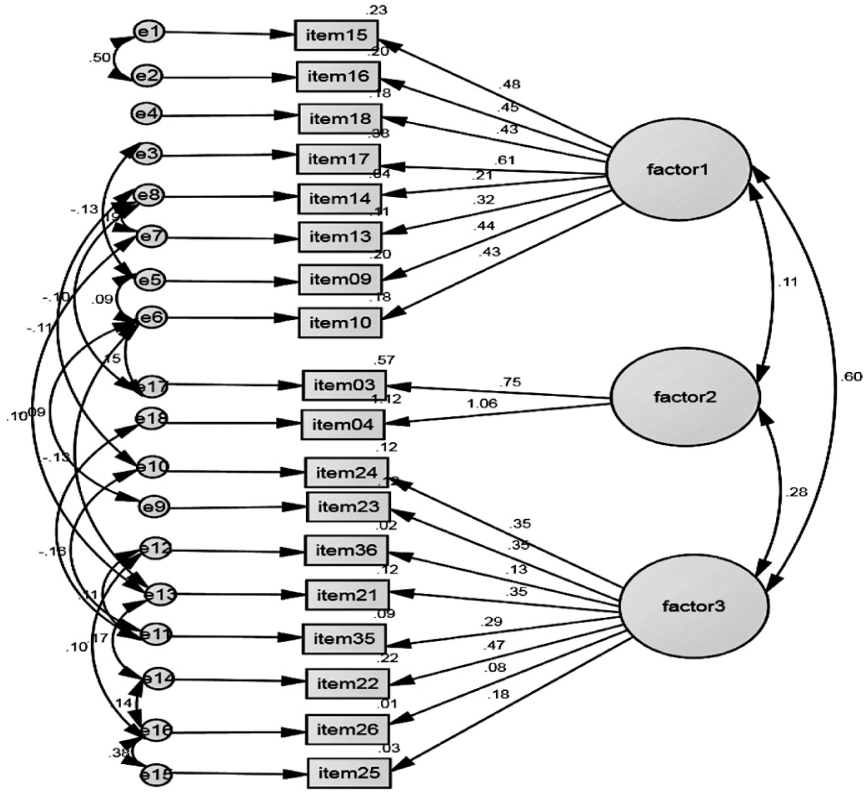

Figure 3. The MPS learner's view model

The Macroscopic, Particulate, and Symbolic (MPS) Learner's View Model portrays that there are three factors affecting students learning in chemistry. It also shows the following relationships of the factors of learning: strong relationship (.60) between learner's macroscopic view and the learner's symbolic view, modest relationship (.11) between learner's macroscopic view and the learner's particulate view and also modest relationship (.28) between learner's particulate view and learner's symbolic view based on Dancy and Reidy's (2004) categorization.

However, most of the items did not significantly represent the factors that were portrayed in the model having Beta values <0.70 and p-values >0.01 except items 3 and 4 which represent the learner's particulate view. Findings imply that students' constructed knowledge on symbolic representations in Chemistry like formula, equations, graphs of the relationships of pressure, temperature, number

of moles and volume in gas laws would be strongly affected by what they have seen or experienced. This suggests that to have better learning of the symbols and terms used in chemistry, teachers should link them with chemical concepts and principles with practical application and relate them to students' life experiences as suggested by CHED (CMO No. 18 series of 2007) for General Inorganic Chemistry.

The findings of the teacher's syllabi content analysis and semi-structured interview may support why the other factors were not significantly represented by their TTCDI responses. Having inadequate constructed knowledge on particulate nature of matter (only items 3 and 4) suggests thatstudents' knowledge on the Kinetic Molecular Model may also be inadequate. Such inadequacy on the constructed knowledge on the particle model of matter may largely determine if one can continue learning chemistry (Kind, 2004).

Conclusions

Students in General Inorganic Chemistry 1 have inadequate constructed knowledge on the fundamental concepts and principles in properties, behaviour and changes of matter (43%), atomic structure and periodicity (38%), and chemical bonds (0%).

The researcher concludes that there are three factors of learning affecting learning chemistry. These are thelearner's macroscopic, particulate, and symbolic views.

The researcher concludes that constructed knowledge of learners in General Inorganic Chemistry 1 in the three selected topics is composed of the learner's macroscopic views on physical and chemical properties of a substance, including the changes they undergo which are strongly related (.60) to the learners' symbolic views on the atomic structure and periodicity that includes the three fundamental particles of an atom and their corresponding characteristic properties, symbolic representations of the quantum numbers and electronic configuration ; and modestly related (.11) to learners' particulate view on molecular arrangement of matter.

Furthermore, the developed TTCDI is substantially reliable (.67) in assessing students' constructed knowledge on the fundamental concepts and principles in properties, behavior and changes of matter, atomic structure and periodicity, and chemical bonds. TTCDI items are average difficult (.47) that supports the internal reliability of the instrument, with good discriminating

index value (.26) that suggests that the TTCDI is a good formative tool because it could differentiate those who have learned the content and those who have not.

The researcher concludes that using the developed and validated TTCDI, the MPS Learner's View Model is the best fitting structural model that portrayed students' constructed knowledge on the three selected topics in General Inorganic Chemistry 1 having the three factors of learning: macroscopic view on properties and behavior of matter and the changes they undergo, particulate view on the molecular arrangement of matter, and symbolic view on the 3 fundamental particles of an atom, and symbolic representations of quantum numbers and electronic configurations, affecting students' learning in chemistry.

Recommendations

Chemistry teachers may reexamine CHEDs policies and guidelines regarding the learning content of their syllabus to insure that they would include necessary learning contents that would develop the three factors affecting student's learning in Chemistry especially on chemical bonds.

Teachersmay use the developed and validated TTCDI to assess prior knowledge of students on the topics: properties, behavior and changes of matter, atomic structure and periodicity and chemical bonds. Also, lessen teachers' load so they could have time to analyze students' responses to exams.

REFERENCES

BeyzaKaradenizBayrak. (2013). Using Two-Tier Test to Identify Primary Students' Conceptual Understanding and Alternative Conceptions in Acid Base. M evlana International Journal of Education (MIJE) Vol. 3(2), pp. 19-26, 1 August, 2013. Available online at http://mije.mevlana.edu.tr/ Retrieved November 2, 2013 from http://files.eric.ed.gov/fulltext/ED543593.pdf

Chen, C.C., Lin, H.S. & Lin, M.L. (2002). Developing a two- Tier diagnostic instrument to assess high school students' understanding-the formation of images by plane mirror. Proc. Natl. Sci. Counc. ROC(D), 12(3), 106-121.

Chandrasegaran, A.L., Treagust, D.F. & Mocerino, M. (2007). "The Development of a Two-tier Multiple-choice Diagnostic Instrument for Evaluating Secondary School Students' Ability to Describe and Explain Chemical Reactions using Multiple Levels of Representation". Chem. Educ. Res Practice, 8 (3): 293-307

CMO No. 18 Series of 2007. "Policies and Standards for Bachelor of Science in Chemistry (BSChem). Commission of Higher Education. (2010). Retrieved October 25, 2013, from http://www.ched.gov.ph/

Creswell, J.W. & Plano-Clark, V. (2007). Research Design Qualitative, Quantitative, and Mixed Methods Approaches, Sage: USA

Duit, R., Gropengießer, H. & Kattmann, U. (2005). Towards science education research that is relevant for improving practice: The model of educational reconstruction.

Harrison, A.G. & Treagust, D.F. (2000). Learning about Atoms, Molecules, And Chemical Bonds: A Case Study of Multiple-Model Use in Grade 11 Chemistry, Science Education, 84, 352-381.

Horton. (2004). Student Alternative Conceptions in Chemistry. California Journal of Science Education, 7(2)2007)

Kind, Vanessa. (2004). (Formerly Vanessa Barker). Beyond Appearances, Students' Misconceptions About Basic Chemical

Plitchta, S. & Kelvin, E. (2013). Munro's Statistical Methods For Health Care Research. WoltersKhwer Health/Lippincott Williams & Wilkins

Raagas, E.L. (2010). Assessment and Evaluation of Student Learning: Concepts and Application (3rd edition).

Taber, K.S. (2002). Chemical misconceptions: Prevention, diagnosis and cure, Vol: 1. Theoretical background. London: Royal Society of Chemistry.

Tan, K.C.D., Goh, N.K., Chia, L.S. & Treagust, D.F. (2002). Development and Application of a Two-tier Multiple Choice Diagnostic Instrument to Assess High School Students' Understanding of Inorganic Qualitative Analysis, J. Res. Sci. Teach. 39: 283-301.

TIMMS. 2003. Retrieved October 28, 2013 from eduphil.org/timms-Results-for-the- philippines, html

Vermette, P. & Foote, C. (2001). Constructivist Philosophy and Cooperative Learning Practice: Toward Integration and Reconciliation in Secondary Classrooms. American Secondary Education. 30(1). 26-37.

Print ISSN 1656-0604
Online ISSN 2244-6532

Psychology and Theology

Emotional Competence, Academic Performance and Work Related Variables as Predictors of Student Assistants' Work Ethics

Mona L. Laya and Ma. Veronica B. Cruzada[1]
University of the Immaculate Conception, Davao City, Philippines
[1]Corresponding author's email address: mcruzada@uic.edu.ph

ABSTRACT

Attending to the queries of students and visitors in different areas, the Student Assistants (SA) of the University of the Immaculate Conception (UIC) are in the frontline of the institutions' support services. Thus, the SA's recognition of their need to balance and improve their work and studies is necessary to bring about positive outcome not only to UIC but to their life as a whole. This study investigated the effects of emotional competence, academic performance, and work related variables to the work ethics of 89 SAs in the three campuses of UIC. Likewise, it determined the difference in the SA's work ethics and emotional competence when they are grouped according to work-related profile. This study utilized researcher-made questionnaires and qualitative techniques in gathering needed data, which were statistically analyzed using multiple regression and t test. The results revealed that the SAs are emotionally competent and manifest evident work ethics. Overall, their academic performance is high which correlates to their ability to balance work and studies. Emotional competence, area of assignment, and duty shift are the predictors of work ethics, and work ethics and emotional competence of the SAs significantly differ with respect to their area of assignment.

KEYWORDS: Psychology, emotional competence, work ethics, student assistant, academic performance, Davao City, Philippines

INTRODUCTION

The University of the Immaculate Conception (UIC) is one of the catholic schools in the Philippines that promote excellence among the students and teachers. It is a service-oriented school where teachers and students are expected to show determination and perseverance in meeting responsibilities; accept tasks willingly; and show tactfulness and refinement in actions and in words. To meet the needs of various stakeholders, like of those individuals who cannot afford but are willing to pursue higher education, the University has been offering the Student Assistance Grant Program or SAGP (UIC Student Handbook, 2013).

Through the years, the SAGP is successful in helping young individuals to pursue education and at the same time prepare them for work after graduation. In Section II, Rule 6, Book 3 of the Rules and Regulations Implementing the Labor Code of the Philippines, as amended, there is no employer-employee relationship between the students and schools, colleges or universities, where students work for the latter in exchange for the privilege to study free of charge. Their work in the academe is considered an opportunity for both the academe and the student assistant to achieve their goals. Student assistants are assigned to various positions in the academe, some are assigned as clerks in offices, some are in the bookstore, canteen, laboratories and others.

Essentially, an SA is a student scholar who provides additional support mechanism to the school. Last June 2014, the University's Human Resource Officer (HRO) implemented job rotation among the SAs. Other than those SAs assigned in the laboratories and some selected offices, majority of the SAs were affected by the recent rotation. Some have difficulty adjusting to the newly assigned office, while others easily adjust due to a less demanding nature of the job. The job rotation aimed to make the SAs well rounded but few studies were conducted to substantiate that such program is effective in developing their skills.

Although the SAs in the University do not have a specific group membership, they have a direct line of communication with the school's HRO to receive directives, acquire knowledge and information in dealing with their supervisors, co-workers, and in handling clients. However, there are instances when the SAs fail to do their responsibilities in school and in the areas they serve. Work ethics among SAs is necessary. In this research, work ethics refers to the ability of the SAs to deal with their immediate supervisor, co-workers, and clients. They must have the ability to respond well to the challenges of having to study and work at the same time. Human beings are rational, thus are obligated to act based on a certain set of principles or moral laws whether in or outside of their workplaces.

Ideally, the SAs' concerns about their studies and family should not influence their obligations at work.

Other than work ethics, SAs also need to have high emotional competence. Emotional Competence is measured in terms of personal competence, self-regulation, self-motivation, social awareness, and social skills. Emotional Intelligence is the backbone for emotional competence, and emotional competence is an expression of emotional intelligence (Stone, 2012; Seal & Andrews-Brown, 2010). Moreover, Goleman (1998) defined emotional competence as a learned capability tested based on emotional intelligence which results in outstanding performance at work. According to the Emotional Intelligence Theory of Daniel Goleman (1998) individuals have two brains and balancing the use of the two brains determines the success and failure of a person in life. Another important theory is the Contingency Model of Management of Boyatzi (1982), which posits that individuals' vision, value system, knowledge and style, job demand in terms of task and roles, and organization demands are integral. Combining the theories of Goleman (1998) and Boyatzi (1982), would mean now that SAs would be effective at work if they possess personal competencies on self-regulation, self-motivation, social awareness, and social skills. An emotionally competent SA is necessary since their place of assignment is considered critical because some of them have access to sensitive information. The SA should embody the vision and mission of the school. Emotional competence ensures that SAs have the motivation to keep learning and improving in the job, are able to work cooperatively with others and have self-discipline as part of their work habit (Weisinger, 2013); and would be able to joggle their schedule at work and studies successfully (Bar-On, 2002), with neither being compromised. The success of a student assistant in his work and studies is the success also of the organization who provided them the opportunity. It is in this light that the researchers aimed to assess the emotional competence and work ethics of student assistants.

Study Objectives. This study intended to determine the predictors of student assistants' work ethics, specifically work related variables (number of years as a student assistant, area of assignment, and duty shift), levels of emotional competence (self-awareness, self-regulation, self-motivation, social awareness and social skill), academic performance, and manifest level of work ethics (relations with their immediate supervisor, the people they work with, their customers, and with their teachers). Moreover, this study also determined the difference in the level of emotional competence and work ethics of the SAs when they are grouped according to their profile.

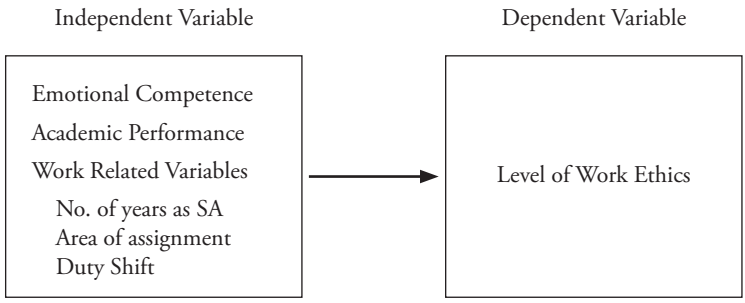

Figure 1. Conceptual framework of the study

The student assistants' emotional competence, academic performance, and work related variables (number of years as a student assistant, area of assignment, and duty shift) serve as the independent variables in this study, and which are supposed to influence the level of their work ethics, as the dependent variable in this study. It is assumed that with higher emotional competence and academic performance, SAs would be more effective in their work in terms of dealing with their supervisor, coworkers and clients.

METHOD

The study employed comparative approach in evaluating the predictors of work ethics of the student assistants. Moreover, qualitative techniques, particularly, focus grouped discussion (FGD) was used to delve on the experiences of the SAs. The FGD questions were based on the extreme responses of the SAs after the survey. Eighty nine SAs assigned in different offices or areas in the three campuses of the University of the Immaculate Conception in Fr. Selga St., Bonifacio St. and Bajada, Davao City were the respondents in the study, as well as the SAs' supervisors/teachers who evaluated their work ethics. The SAs were from the Liberal Arts, Education, and Accountancy and Business Administration programs since SAs are allowed to take courses under these programs only.

The researchers utilized two questionnaires, for the SA and the Supervisor/Teacher. The SA questionnaire was composed of three parts: the profile, level of work ethics and level of emotional competence. The supervisor/teacher questionnaire was composed of the work ethics of the SA. The questionnaire on work ethics is researcher-made and subjected to validity and reliability tests.

It was composed of 10 statements each about the SAs' relations with their supervisor, people they work with, the clientele they serve, and their teachers. The questionnaire on emotional competence was based on the emotional competence framework of Spencer and Spencer (1995). It was composed of 10 statements each about self-awareness, self-regulation, self-motivation, social awareness, and social skills. All questionnaires were designed with a five-point likert scale answerable by strongly agree, agree, neither, disagree and strongly disagree. The respondents' answers were collated, taking into account statements or items with striking answers, meaning those marked either very low or very high, which then became the basis for the FGD. The data were analyzed by multiple regression to determine the predictors of work ethics, and t test to determine significant difference in emotional competence and work ethics when the respondents are grouped according to profile variables.

RESULTS AND DISCUSSION

Profile of the SAs

Table 1. Work related profile of the respondents

Variable	Category	Bonifacio Campus		Fr. Selga Campus		Bajada Campus			
						Grade School		High School	
		f	%	f	%	f	%	f	%
No. of Years as SA	1 - 2	8	32	10	42	11	34.3	10	43.4
	3 - 4	13	52	9	37	20	62.5	12	52.2
	5 - 6	4	16	5	21	1	3.1	1	4.3
Area of Assignment	Library	8	32	1	4	19	59.3	9	39.1
	Laboratory	9	36	14	58	6	18.7	9	39.1
	Clinic	6	24	4	17	2	6.3	2	8.6
	Office	1	4	3	13	2	6.3	0	0
	Canteen	1	4	2	8	3	9.3	3	13
Duty Shift	AM or PM	5	20	11	46	21	65.5	11	47.7
	Broken Time	20	80	13	54	11	34.3	12	52.2

Table 1 shows that most of the participants have been serving the university for three to four years. Most are assigned to work in laboratories and have broken time work schedule. This is expected as UIC has various laboratories namely IT and Computer, Manufacturing, Physics, Engineering and Speech laboratories; and since SAs work only outside their class schedules. The area of assignment may also affect their schedule, depending on the magnitude of their tasks and demands by their supervisors. This means that SAs assigned in offices are not that busy compared to those assigned in laboratories, libraries, and canteens.

Based on FGD results, the SAs vary in their reasons why they have to work while studying. Some need to help their parents in the payment of their tuition; others wanted to study and without the scholarship they would not be able to study at all. In terms of work schedule, some participants revealed that they sometimes request their co-worker to fill-in for their shift in times that they needed to do something during their working hours. In some instances, they are asked by their supervisors to work overtime, especially during weekends when needed, which they admit affect their social and family relationships. According to Lundberg (2004), students working more than 20 hours per week reported significantly fewer interactions with faculty and lower quality student relationships with peers.

Level of emotional competence

Table 2a. Level of emotional competence based on self-awareness

Personal Competence	Mean	SD	Interpretation
			The SAs are…
Can explain the reason of the feeling.	4.02	0.74	emotionally competent
Realize the link between ones' feelings and action.	4.03	0.67	emotionally competent
Recognize how feelings affect performance.	4.26	0.59	very much emotionally competent
Aware of ones' strengths and weaknesses.	4.22	0.68	very much emotionally competent
Open to feedback, new perspectives, continuous development and self-development.	4.31	0.61	very much emotionally competent
Voice views that are unpopular.	3.69	0.75	emotionally competent
Decisive and able to make sound decision.	3.80	0.71	emotionally competent
Present oneself with self-assurance.	3.97	0.73	emotionally competent
Have a guiding awareness of ones' values and goals.	4.28	0.69	very much emotionally competent
Reflects from experience.	4.38	0.69	very much emotionally competent
Category Mean	4.09		emotionally competent

Table 2a reveals that the SAs are generally emotionally competent (M = 4.09). Specifically, they are very much emotionally competent in terms of contemplating on their experiences, being open to criticisms, knowing their values and goals, realizing how their feelings affect their performance, and being aware of their strengths and weaknesses. This implies that the participants see their experience from work whether positive or negative, as favorable. According to them, when they are scolded by their supervisor, they understood it as important part of learning, they are still thankful because it still has a positive impact to them.

Meanwhile, the SAs need to improve their self-confidence, their determination in making decisions, and their assertion in saying unpopular views. This does not mean that the SAs are uncomfortable in confiding issues relating to their work mates' unwanted behaviors (noisy, tardy, lazy, spreading rumors) to their supervisors, but it is their way of distancing themselves from conflict.

Table 2b. Level of emotional competence based on self-regulation

Self-Regulation	Mean	SD	Interpretation
			The SAs are…
Can manage impulsive feelings.	3.96	0.79	emotionally competent
Can think clearly and stay focused under pressure.	3.96	0.71	emotionally competent
Can admit own mistake and confront unethical actions of others.	4.19	0.67	emotionally competent
Can meet commitments.	4.03	0.74	emotionally competent
Can smoothly handle multiple demands.	3.88	0.69	emotionally competent
Can seek out fresh ideas from a wide variety of source.	3.96	0.81	emotionally competent
Can generate new ideas.	3.91	0.74	emotionally competent
Can adapt responses and tactics to fit fluid circumstances.	3.95	0.74	emotionally competent
Organized and careful in the work.	4.24	0.68	very much emotionally competent
Can hold accountable for ones' objectives.	4.10	0.79	emotionally competent
Category Mean	4.01		emotionally competent

Stony (2011) explained self-regulation, behaviorally, as being able to act in their long-term best interest and consistent with their deepest values. Emotionally, it is the ability to calm one-self down when upset and cheers oneself up when feeling down. The results revealed that the SAs are generally emotionally competent (M = 4.01). According to the SAs, if they have nothing to do, they find ways to do something, so as not to waste time, or help those who are not yet done in their task. This explains why the SAs can admit mistake and confront unethical actions of others, be accountable to their own objectives, meet commitments, and manage impulsive feelings, staying composed even under pressure.

Meanwhile, the SAs need to develop more their ability to handle smoothly multiple demands. This poses a challenge among their supervisors to help them carryout multiple demands or collaborative work with their co-workers. In a study conducted by Mark, Gonzalez and Harris (2005), it was revealed that individuals constantly renew overviews of their working spheres, they strategize

how to manage transitions between contexts and they maintain flexible foci among their different working spheres.

Table 2c. Level of emotional competence based on self-motivation

Self-Motivation	Mean	SD	Interpretation
			The SAs are…
Result-oriented.	4.12	0.68	emotionally competent
Can set challenging goals.	4.15	0.75	emotionally competent
Learn how to improve ones' performance.	4.26	0.71	very much emotionally competent
Can readily make personal or group sacrifices to meet a larger organizational goal.	4.03	0.89	emotionally competent
Can find a sense of purpose in a larger mission.	4.02	0.74	emotionally competent
Actively seek out opportunities to fulfill the group's mission.	4.00	0.76	emotionally competent
Ready to seize opportunities.	4.17	0.78	emotionally competent
Can pursue goals beyond what is expected.	4.11	0.66	emotionally competent
Operate from hope of success rather than fear of failure.	4.08	0.81	emotionally competent
Can see setbacks as due to manageable circumstances rather than a personal flaw.	3.94	0.71	emotionally competent
Category Mean	4.08		emotionally competent

Table 2c reveals that the participants are emotionally competent in terms of self motivation (M = 4.08). It is also interesting to know that based on the results, most of the SAs are able to learn how to improve their performance. As a matter of fact based on the FGD conducted, most of the participants revealed that they do their best at work so that they may be able use their skills in the future as professionals. Similarly, the years of their experience as student assistants (3 to 4 years) have also been a factor to improve their capabilities. In like manner, Choy (2002) reported that 26% of students who considered themselves students who worked, thought that working helped them with their course work, and

55% thought it helped to prepare them for a career (Tuttle, McKinney, & Rago, 2005).

The results also reveal that some participants see setbacks as manageable circumstances rather than a personal flaw. This means that the SAs continuously try to improve on how they handle difficult situations. According to one of the SAs she has to work, because if not, her mother is not capable of sending her to school. Thus, she realizes that being a working student is an opportunity for her to improve more in terms of balancing the situation in her work and studies. During the FGD, some participants revealed how their family, friends, and immediate supervisors have helped them to manage difficulties. One of the SAs revealed that her supervisor even helped her in the assignments and allowed them to use the computer. Another SA said her co-workers would discuss among themselves which schedule and subjects they have to take to avoid conflicting schedules with their studies.

Table 2d. Level of emotional competence based on social awareness

Social Awareness	Mean	SD	Interpretation
			The SAs are…
Attentive to emotional cues.	3.94	0.75	emotionally competent
Help out based on understanding other people's needs and feelings.	4.01	0.74	emotionally competent
Understand client's needs.	4.14	0.79	emotionally competent
Seek ways to increase client satisfaction and loyalty.	4.20	0.76	very much emotionally competent
Gladly offer appropriate assistance.	4.13	0.91	emotionally competent
Acknowledge people's strengths.	4.20	0.73	very much emotionally competent
Relate well to people from varied backgrounds.	4.08	0.84	emotionally competent
Understand diverse worldviews.	4.05	0.80	emotionally competent
See diversity as opportunity.	4.02	0.78	emotionally competent
Can accurately read key power relationships.	3.89	0.68	emotionally competent
Category Mean	4.06		emotionally competent

The result reflects a category mean of 4.06 implying that the SAs are emotionally competent in terms of social awareness. Notably, the SAs rate very much emotionally competent in seeking ways to increase client satisfaction (M = 4.20). These days, customers are becoming increasingly more demanding, less tolerant, and very critical when not having their expectations met. This is the reason why student assistants should serve them properly. Aside from that, the College Department is also known for its core values and signpost IGNITES, where the S stands for being service-oriented. This indicates that the SAs really carryout not only what are expected of them, but more that they know is right. In relation to that, a study conducted by Mostaghel (2006) about customer satisfaction revealed that customers' needs and preferences, and their related quality dimensions have increasingly become a key driving force in enhancing customers' satisfaction.

Meanwhile, the results also reveal that the SAs acknowledge people's strengths. As a Catholic University, it is expected that everyone treat others fairly, recognizing every persons' strengths and capabilities. It is also important to know that some student assistants are education students. Part of their training as teachers-to-be is to recognize their students' strengths' so that they may be able to provide the help that each of their students need. Aside from that, It is also part of the University's mission that they serve others with humility and love, and by recognizing ones strengths is one of the many ways of serving others. In relation to that, Carter (2014) said that acknowledging someone's inner strengths is a great way to show that you see and care about who they are on the inside.

In terms of being sensitive to others' emotions, during the FGD, the SAs specifically revealed that if they already knew that their supervisor is not on good mood, they make sure that they do not commit mistakes. As what Heathfield (n.d.) said, the difficulty of a person to deal with depends on the self-esteem, self-confidence and professional courage of the other. In psychology, flight or fight would mean the instinctive physiological response to a threatening situation, which readies one either to resist forcibly or to run away.

Table 2e. Level of emotional competence based on social skills

Social Skills	Mean	SD	Interpretation
			The SAs are…
Skilled at persuasion.	3.74	0.74	emotionally competent
Can fine-tune presentations to appeal to the listener.	3.75	0.79	emotionally competent
Deal with difficult issues straightforwardly.	3.83	0.75	emotionally competent
Can step forward to lead as needed.	4.07	0.69	emotionally competent
Challenge status quo to acknowledge the need for change.	3.95	0.69	emotionally competent
Can handle difficult people with diplomacy.	3.81	0.83	emotionally competent
Can seek out relationships that are mutually beneficial.	3.88	0.82	emotionally competent
Can promote a friendly climate.	4.13	0.81	emotionally competent
Can model team qualities like respect.	4.16	0.84	emotionally competent
Can draw all members into active participation.	4.00	0.85	emotionally competent
Category Mean	3.93		emotionally competent

Table 2e shows a category mean of 3.93, which means that the participants are emotionally competent in terms of social skills. Particularly, the participants show modeling qualities like respect, implying that based on the number of years as student assistants (mostly 3 to 4 years), the SAs have already learned the skills that they need to perform their job. According to the SAs, their supervisor reprimanded them if they themselves have conflict. Moreover, the SAs can handle difficult people with diplomacy. According to one of the SAs, in their area of assignment, they have this diary notebook where everybody can write what they wanted their co-workers to know and do. According to her, it is better that way especially if the SA is shy or afraid to tell her co-workers. The participants got the lowest mean (3.74) in terms of being skilled at persuasion. This result should not be interpreted negatively, but only signifies that the SAs still need to improve and develop their skills in convincing and influencing their co-workers. According to McIntosh and Luecke (2011) influence give people the ability to have an effect on others in the workplace, making it an important skill for success. In addition, they said that people whom co-workers can rely upon to follow through on commitments earn themselves respect.

Academically, the SAs have high grades (M = 83.66). This means that they are emotionally competent since they were able to manage work and studies at the same time (Bar-On, 2002). According to the participants, if they are not too busy in their work they take time to study; this implies that the participants can stay focused even under pressure, which is an indicator of self-regulation. Nikolaou, and Tsaousis, (2002) confirmed that an emotionally competent individual can balance work and life. Moreover, in the study of Brackett et al., (2012) and Brackett et al., (2013) a socially and emotionally competent child has a higher year-end grade. Furthermore, according to the participants, since they are only required to work four hours in a day, they still have time to study.

Level of work ethics of SAs

Table 3a. Level of work ethics based on relations with the immediate supervisor

Indicators	According to the SA		According to the Supervisor	
Relations with Immediate Supervisor	Mean	Interpretation	Mean	Interpretation
		Work ethics of SAs are…		Work ethics of SAs are…
Can express disagreement with the supervisor.	3.22	moderately evident	3.48	evident
Can easily ask question to the supervisor.	3.99	evident	4.22	highly evident
Can make a suggestion to the supervisor.	3.50	evident	4.07	evident
Supported by the supervisor concerning studies.	3.72	evident	4.27	highly evident
Important issues are well communicated to the supervisor.	3.80	evident	4.16	evident
Always follow the rules of the supervisor.	4.18	evident	4.11	evident
Receive appropriate feedback about their performance.	3.80	evident	4.02	evident
Can disclose all significant errors encountered in the job to the supervisor.	3.60	evident	3.84	evident
Can report instances of incompetent co-workers to the supervisor.	3.08	moderately evident	3.86	evident
Can freely discuss issues concerning studies.	3.32	moderately evident	4.09	evident
Category Mean	3.62	evident	4.01	evident

Table 3a presents a category mean of 3.62 for student assistants and 4.01 for their supervisors. This means that the work ethics of the student assistants are evident and affirmed by their supervisors' evaluation. Specifically, the SAs show an evident level of work ethics in terms of following rules as determined by their supervisors (M = 4.18) and moderately evident in reporting incompetent co-workers (M = 3.08). This means that their supervisors saw and experienced that the SAs are doing their job within the bounds the rules and regulations of the organization and they have rarely heard from the SAs report about their co-workers.

On the contrary, the supervisors and the SAs have different perceptions with regard to the supervisors support in their studies (4.27 and 3.48 respectively) and in terms of showing and expressing disagreements with them (3.72 and 3.22 respectively). This means that some SAs may have experienced very strong support from their supervisor but some have not felt any support at all, some may have express disagreements with their supervisor and some may have chosen to keep quiet.

In connection, it is interesting to know that before the employee reshuffling, happened sometime on 2014, some student assistants have been working and serving other supervisors for quite a long time. With these years of experience, supervisors have ample of time to get to know and be comfortable with their assistants and just the same, student assistants to their supervisors. These inconsistencies between the SA – Supervisor relationship can mean opportunities for enhancement.

Table 3b. Level of work ethics based on relations with the people they work with

Indicators	According to the SA		According to the Supervisor	
Relations with co-workers	Mean	Interpretation	Mean	Interpretation
		Work ethics of SAs are…		Work ethics of SAs are…
Accept suggestions from the people they work with.	4.35	highly evident	4.27	highly evident
Introduce ways to make the job effective.	4.15	evident	4.02	evident
Can express disagreement with the people they work with.	3.66	evident	3.79	evident
Supported by the co-workers.	4.01	evident	4.12	evident
Can ask assistance from the people they work with.	4.17	evident	4.34	highly evident
Can easily exchange schedule if needed with the people they work with.	3.65	evident	4.05	evident
Willing to work for the improvement of the service with the people they work with.	4.34	highly evident	4.23	highly evident
Can freely discuss issues concerning studies and work with the people they work with.	4.12	evident	4.25	highly evident
Can express feelings of frustration regarding studies and work with the people they work with.	3.85	evident	4.11	evident
Can borrow things to the people they work with.	3.86	evident	3.75	evident
Category Mean	4.01	evident	4.09	evident

The SAs rate their work ethics based on their relations with the people they work with as evident (M = 4.01), which is highly affirmed by their supervisors (M = 4.09). This shows that the SAs have amicable relationship with their co-workers, and in fact manifest highly evident work ethics in terms of accepting suggestions, willingness to improve the service for the people they work with, and asking assistance.

However, in terms of borrowing things and swapping schedule, the SAs still have to improve since some of them experienced difficulty in changing their schedules because a co-worker failed to coordinate with them before enrolling. According to the SAs, they have to make sure that their co-workers do not have the same schedule as theirs that is why; they give consideration to the graduating SA.

Table 3c. Level of work ethics based on relations with the customers

Indicators	According to the SA		According to the Supervisor	
Relations with customers	Mean	Interpretation	Mean	Interpretation
		Work ethics of SAs are…		Work ethics of SAs is…
Smiles at anybody they encounter.	4.31	highly evident	4.00	evident
Asks the customer how they may be helped.	4.31	highly evident	4.02	evident
Greets every person who walks through the door.	4.17	evident	4.00	evident
Stops doing paper-works, etc. if a costumer comes in the office.	4.12	evident	4.00	evident
Accompanies people to the right area or department rather than merely pointing and saying "it's over there".	3.91	evident	3.96	evident
When speaking to anyone about credit problems or any difficulty, they politely take them away from the area of other customers to speak with them in a non-public area.	3.81	evident	4.06	evident
Always says "thank you."	4.46	highly evident	3.04	moderately evident
Does not make personal phone calls when serving a customer.	4.13	evident	4.17	evident
Accepts criticisms from the customer constructively.	4.07	evident	4.07	evident
Speaks softly when dealing with the customer.	4.37	highly evident	4.20	highly evident
Category Mean	4.16	evident	3.95	evident

The SAs rate their work ethics in terms of their relations with customers as evident (M = 4.16), which is affirmed by their supervisors though to a slightly lower level (M = 3.95). In fact, the SAs, as confirmed by their supervisors, have highly evident work ethics in terms of saying thank you and speaking softly when dealing with costumers. Studies have suggested that being grateful can improve well-being, physical health, can strengthen social relationships, produce positive emotional states and help us cope with stressful times in our lives. In addition, studies have revealed that gratitude is more than just a social nicety, or a way of making the helper feel good; it reassures others their help was actually appreciated and it encourages further pro-social behavior (Dean, 2010).

Also, both the SAs and their supervisors agree that SAs evidently accompany people to the right area or department rather than merely pointing the direction and when speaking to anyone about any difficulty, they politely take them away from the area of other customers to speak with them in a non-public area. This means that the College Department's core value of being service-oriented is reflected in the SAs' work and behavior. Similarly, Parasuraman, Zeithaml, and Berry (1985) found that the customer's perception of service quality depends on the range of gap between the customer before a service is received and what he or she actually perceived after they see and use the service by their own. Thus, service quality is in fact defined as the gap between customers' expectation of service and the perception of the service experience.

This result contradicts the study conducted by Fen and Lian (n.d.), which concludes that their patrons' perception towards service quality level provided was consistently lower than their expectation. This implies that more effort is needed to improve the service quality.

Table 3d. Level of work ethics based on relations with the teacher

Indicators	According to the SA		According to the Supervisor	
Relations with the teacher	Mean	Interpretation	Mean	Interpretation
		Work ethics of SAs are…		Work ethics of SAs is…
Never called the SAs attention because of being late.	3.31	moderately evident	3.98	evident
It was clear that the SA should be treated like other students.	4.07	evident	4.66	highly evident
Have not asked special considerations from the teacher.	3.89	evident	2.17	less evident
Have not felt "abused" if asked constantly by the teacher to do something.	4.25	highly evident	4.38	highly evident
Can answer the questions asked by the teacher in class.	3.99	evident	4.14	evident
Attentive when the teacher starts to discuss.	4.04	evident	4.28	highly evident
Was never scolded by the teacher.	4.00	evident	1.77	less evident
Have not accepted favor from the teacher.	3.20	moderately evident	2.21	less evident
Do not give consideration to the teacher when the SA encounters her/him in the duty.	3.34	moderately evident	3.21	moderately evident
Can open my feelings/ideas to my teacher.	3.21	moderately evident	3.54	evident
Category Mean	3.73	moderately evident	3.43	evident

The SAs rate their work ethics based on their relations with their teachers as moderately evident (M = 3.73), which is affirmed by their supervisors though to a slightly lower level (M = 3.43). This means that there may be some SAs that teachers find unfavorable with regard to their work ethics. Moreover, the SAs and their teachers vary in opinion in terms of the SAs' work ethics when being reprimanded , asking special consideration from the teacher, and accepting favor from the teacher, all are rated higher by the SAs and lower by the teachers. This may be because, according to the SAs, they come to class late because of the

kind of working hours they spend at work, some of them may have asked special considerations in order not to be dropped from the class or failed in the subject. This could be the reason why there were instances when they were scolded by their teachers. According to Furr and Elling (2000), 29% of the students working 30-39 hours per week and 39% of those students working full time indicated that work had a negative and frequent impact on their academic progress. In contrast, the result of the study conducted by Sun and Shek (2012), revealed that teachers perceived student problem behaviors as those behaviors involving rule-breaking, violating the implicit norms or expectations, being inappropriate in the classroom settings and upsetting teaching and learning, which mainly required intervention from teachers.

Statistical Analyses

Table 4. Predictor of work ethics

Predictor	Standardized Coefficient Beta	t	p -value
Emotional Competence	.467	6.410	.000
Academic Performance	.000	-.005	.952
Number of years as SA	.045	.080	.361
Area of Assignment	-.217	-.203	.023
Duty Shift	.182	.077	.021
R = .634	r^2 = .402	F = 10.757	p = .000

Multiple regression analysis reveals that emotional competence, area of assignment and duty shift are predictors of work ethics. This means that for every unit increase in the emotional competence of the individual, there is a corresponding increase in the work ethics of the SA by .467. According to most of the participants, they cannot totally express their feelings towards their supervisors and peers, and they worked according to what is expected of them that is why they were able to work cooperatively with others and have self-discipline as part of their work habit (Weisinger, 2013). And because of this, the participants, particularly the front liners, were trusted by their supervisor to make decision. Thus, high emotional competence begets better work ethics.

The results also reveal that for every unit change in the area of assignment, there is a corresponding decrease in work ethics by -.217. As the job rotation was implemented, some SAs have difficulty adjusting to the new task assigned to them. According to one of the supervisors, she has difficulty in giving instructions and assignments because there are some SAs who have difficulty coping with new assignments. Some of them were not used to be assigned in a highly demanding area, which explains why they always commit a mistake or fall short of the expectation of their supervisor.

Moreover, for every unit increase in the duty shift of the individual, there is a corresponding increase in the work ethics by .182. In particular, SAs work by shift of four hours a day, allowing them to have time for studies. However, according to one participant, there was a time when the SA assigned to replace him did not arrive and he asked permission to leave because his shift ended and he has to attend an activity in the community, and the supervisor blamed his activity in the community why he could not do his job. He reasoned out to his supervisor, and felt he was disrespecting his supervisor. This situation implies that disruption in the duty shift will result to a negative work ethics like disagreement with the supervisor, and the belief of the SA that he was not supported by his supervisor concerning his studies. In another study, it was known that duty shift affects the work ethics of those working in hospitals (Harrington, 2001).

Furthermore, work ethics have significant influence ($r2=.402$, $p < .01$) to emotional competence, area of assignment and duty shift, which means that 40.2% of the variation in the level of emotional competence, area of assignment and duty shift is attributed to work ethics. It further implies that the remaining 59.8% can be attributed to other factors not covered in the study.

Table 5. Significant difference on emotional competence based on profile (Sig. when p < .10)

	Mean	Emotional Competence		
		F	p -value	Interpretation
Number of Years as SA		1.43	.227	Not significant
Duty Shift		.644	.588	Not significant
Area of Assignment		2.05	*.077	Significant
Library	3.77			
Canteen	3.88			
Laboratory	3.92			
Clinic	3.96			
Office	4.22			

The emotional competence of the SA varies depending on their area of assignment (p = .077). This means that the SAs working in the offices (M = 4.22) are more emotionally competent compared to those working in the clinics (M = 3.96), laboratories (M = 3.92), canteens (M = 3.88), and libraries (M = 3.77). The result somehow confirms the experience of one SA, who was affected by job rotation, and confessed that working in the clinic is better compared to working in the canteen, because her supervisor there is more supportive. In terms of adjustment, she was able to adjust right away because of a better set up. Thus, as a result of her new area of assignment she felt better which positively affects her performance, allowing her to make a sounder decision, because she planned to stop before. Her experience is different to those who were newly assigned in the library because according to some SAs, the newly assigned SAs in the library have more difficulty adjusting with the work demands, affecting them in ways like becoming not open to feedback, not staying focused on their new assignment, and not able to handle multiple demands, which result to disagreements. This experience is quite reasonable since the job rotation took effect last June 2014, thus, they are still adjusting.

On the other hand, those working in the laboratories were not affected by the job rotation, because according to the SAs, their supervisor requested the HRO not to include the laboratories because the work demand there entails mastery, which is necessary to eliminate further expenses (time and money) to the department. However, some studies proved that job rotation is beneficial, for instance, Khan (2010) concluded that higher performers compared to

underperformers are likely to like job rotation because it is perceived to add greater improvement in skills. Similarly, Plowman (2010) believed that job rotation benefits employees who participate by reducing job burn-out, apathy, and fatigue, which ultimately increases the level of employee satisfaction and motivation.

Table 6. Significant difference on work ethics based on profile (Sig. when p < .10)

	Mean	Emotional Competence		
		F	p -value	Interpretation
Number of Years as SA		1.636	.171	Not significant
Duty Shift		.644	.588	Not significant
Area of Assignment		3.586	.005	Significant
Library	3.77			
Canteen	3.88			
Laboratory	3.92			
Clinic	3.96			
Office	4.22			

The work ethics of the SA varies depending on their area of assignment (p=.005). This means that the SAs working in the offices (4.22) have better work relationship with their supervisor, co-workers, customers and teachers compared to those working in the clinic (3.96), laboratory (3.92), canteen (3.88) and library (3.77). This somehow confirms the experience of the SA assigned in the canteen before because according to her, she cannot express disagreement with her supervisor because she is afraid, and with this she does not ask question that leads her to commit mistake. Furthermore, she has difficulty changing her schedule because all of them have the same schedule, and with this she asked favor from her teacher because she cannot cope with their lessons.

On the other hand, the SAs assigned in laboratories felt that they can easily ask questions from their immediate supervisors, and communicate or accept important issues like errors because they said they have been assigned there longer, allowing for a feeling of openness. Moreover, they can ask assistance from the people they work with and have not asked special consideration from

the teacher. To confirm, in a study conducted by Burns (2012), he declared that good employer-employee relations are essential because workers who are inspired to work produce better and more results, their level of competency also increases because of their drive to become better, and costumer service is improved because workers who have good relations with their employers are usually viewed as good costumer consultants. Additionally, according to Hunt, Lara, and Hughey (2009), trust and respect are earned by an employer through open communications, consistent feedback and delegation of responsibilities to the staff. An employer who fails to abide by these elements of trust and respect will eventually put a negative strain on the relationship.

REFERENCES

Bar-On, R. (2002). Emotional and social intelligence: Insights from the Emotional Quotient Inventory. In R. Bar-On & J. Parker (Eds.), Handbook of emotional intelligence. San Francisco, CA: Jossey-Bass.

Boyatzi, R., Goleman, D. & Rhee, K. (1999). Clustering Competencies in Emotional Intelligence from Emotional Competence Inventory (ECI). Retrieve from https://weatherhead.case.edu. Retrieved on November 24, 2015.

Brackett, M.A., Rivers, S.E., Reyes, M.R. & Salovey, P. (2012). Enhancing academic performance and social and emotional competence with the RULER feeling words curriculum. Learning and Individual Differences.

Brackett, M.A., Bertoli, M., Elbertson, N., Bausseron, E., Castillo, R. & Salovey, P. (2013). Emotional intelligence. Handbook of cognition and emotion.

Burns, A. (2012). Employee Relations. In Prescott RK, Rothwell WJ (Eds.) Encyclopedia of Human Resource Managements, Key Topics and Issues. John Wiley & Sons.

Carter, K. (2014). Acknowledging People's Strengths Can Change Their Lives. Start with your strengths. Retrieved on http://startwithyourstrengths.com/acknowledging-peoples-strengths-can-change-their-lives/ret.

Choy, S.P. (2002). Access & Persistence: Findings from 10 Years of Longitudinal Research on Students. ERIC Digest. Retrieved from April 18, 2015.

Dean, J. (2010). Why thank you is more than just good manners. Retrieved from http://goo.gl/a0bj retrieved on April 18, 2015.

Fen, Y.S. & Lian, K.M. (n. D.). Service quality and customer satisfaction: Antecedents of customer's re-patronage intentions.

Furr, S.R. & Elling, T.W. (2000). 'The influence of work on college student development,' NASPA Journal.

Goleman, D. (1998). Working with emotional intelligence. New York: Bantam.

Heathfield, S.M. (n.d.). How to Deal With Difficult People at Work. Why You Must Deal With Difficult People? About money. Retrieved from http://humanresources.about.com/od/workrelationships/a/difficultpeople.htm retrieved on April 22, 2015.

Harrington, J.M. (2001). Health effects of shift work and extended hours of work. Occupational and Environmental Medicine

Hunt, M., Lara, T.M. & Hughey, A.W. (2009). Establishing and Maintaining Organizational Trust in the 21st Century. Industry and Higher Education.

Ibrahim, H.I. (2014). The Relationship between Job Stress, Co-Worker Support and Organization-Based Self-Esteem: A Survey across Different Occupations. Researchers World.

Khan, F. (2010). Study Clarifies Job Rotation Benefits. Retrieved from http://www.peoplehrforum.com/index.php?view+tpl_topics_detail&topic_id=1057&forum_id=196 Retrieved on April 2016.

Lundberg, C.A. (2004). Working and learning: The role of involvement for employed students. NASPA Journal.

Mark, G., Gonzalez, V.M. & Harris, J. (2005, April). No task left behind?: examining the nature of fragmented work. In Proceedings of the SIGCHI conference on Human factors in computing systems. ACM.

McIntosh, P. & Luecke, R. (2011). Increase Your Influence at Work. American Management Association.

Mostaghel, R. (2006). Customer satisfaction: Service quality in online purchasing in Iran. Retrieved from epubl.ltu.se/1653-0187/2006/58/LTU-PB-EX-0658-SE.pdf retrieved on April 21, 2015.

Ng, T.W.H. & Sorensen, K.L. (2008). Toward a further understanding of the relationships between perceptions of support and work attitudes: A meta-analysis. Group & Organization Management.

Nikolaou, I. & Tsaousis, I. (2002). Emotional intelligence in the workplace: Exploring its effects on occupational stress and organizational commitment. The International Journal of Organizational Analysis

Parasuraman, A., Zeithaml, V.A. & Berry, L.L. (1985). A conceptual model of service quality and its implications for future research. the Journal of Marketing.

Polwan, N. (2010). Advantages of Job Rotation: Reduce Turnover by Influencing Employee Burnout, Satisfaction, and Motivation. Retrieved from http://brightbulb.com/office/entrepreneurs/articles/55274.aspx Retrieved on April 2016.

Seal, C.R. & Andrews-Brown, A. (2010). An integrative model of emotional intelligence: Emotional ability as a moderator of the mediated relationship of emotional quotient and emotional competence. Organization Management Journal, 7, 143-152. doi: 10.1057.

Stosny, S. (2011). Anger in the Age of Entitlement. Self-Regulation. To feel better, focus on what is most important. Psychology Today. Retrieved from https://www.psychologytoday.com/blog/anger-in-the-age-entitlement/201110/self-regulation retrieved on April 21, 2015.

Sun, R.C. & Shek, D. T. (2012). Positive youth development, life satisfaction and problem behaviour among Chinese adolescents in Hong Kong: A replication. Social indicators research.

Student Handbook, University of the Immaculate Conception. (2013).

Tuttle, T., McKinney, J. & Rago, M. (2005). College Students Working: The Choice Nexus. A Review of Research Literature on College Students and Work. Retrieved from http://indiana.edu/~ipas1/workingstudentbrief.pdf retrieved on April 21, 2015.

Weisinger, Hendrie. 2013. Be Emotionally Intelligent Manager-Be one! Retrieved from http://goo.gl/9bgkOR retrieved on November 11, 2013.

Print ISSN 1656-0604
Online ISSN 2244-6532

Public Practice of Religion as Predictor of Prosocial Behavior

Jame Bryan L. Batara
University of San Carlos, Cebu City, Philippines
Email: jblbatara@usc.edu.ph

ABSTRACT

Individuals view helping those in need as part of being religious. However, religion has been associated to helping mostly the ingroup and that religious prosociality is heightened mostly during Sundays. This study looked closely on what is in religion that serves to facilitate helping the ingroup and increase helping during Sundays. Through survey, five dimensions of religion were considered and the respondents' influence in willingness to help an outgroup. Results of multiple linear regression analysis indicated that public practice of religion predicted prosocial behavior. This provides an implication to religious individual's minimal prosociality and the Sunday effect.

KEYWORDS: Religion, prosocial behavior, Sunday effect, multiple regression analysis, Cebu City, Philippines

INTRODUCTION

Religious individuals do not just pray. Religious individuals also help. Throughout the globe, it can be observed that religion is intertwined with helping the needy. However, Saroglou (2006) contended that religious helping is minimal prosociality – minimal in a sense that the likely targets of helping are those ingroup or close others. Malhotra (2010) contended that helping is more salient after individuals attended religious services, and that most religious services are on Sundays (Sunday effect). Yet, it is still a wonder on what is in religion that makes the individuals on Sundays more willing to help. With this, the present study looked into the five dimensions of religiosity and which of these dimensions predict/s willingness to help.

Religion includes the feelings, thoughts, and processes that arise from the search for the sacred in the presence of a community that prescribes set of religious practices, or an attempt to reach goals that are not necessarily sacred (e.g., belongingness) but are done in the religious context (Hill, et al., 2000). There are different definitions about religion such as intrinsic and extrinsic religious orientation (Allport, 1966), religious quest orientation (Batson, 1976), and the establishment of rituals to recognize the power of a higher being (Wulff, 1997).

Religion can be viewed as composed of five dimensions namely intellectual, ideology, religious experience, private and public practices (Glock, 1962; Stark & Glock, 1968) and can be measured through centrality of religiosity scale (Huber & Huber, 2012). Huber and Huber (2012) described these five dimensions through the interplay of sociological and psychological perspectives.Intellectual dimension refers to an individual's personal knowledge and social expectations about religion. Ideology dimension refers to religious beliefs and convictions. Religious experience refers to both the personal and social experience related to transcendence. Public practice refers to the participation in the activities of the religious community whereas private practice refers to the religious activities that an individual engages into in his/her personal sphere.

On the other side, prosocial behaviors are intended to benefit others either directly or indirectly (Preston, Salomon & Ritter, 2013). Recent studies haveindicated the causal contribution of religiosity in prosocial behavior (for review, see Preston, Ritter & Hernandez, 2010). There have been growing studies on the associations of religiosityand prosocial behaviors (Saroglou, 2013).

In terms of experimental studies, results came mostly from priming religious context and concepts. It was found that in the presence of church and other

religious infrastructures, there was decreased theft and violence toward others (Bainbridge, 1989) and an increased intention to help (Pichon & Saroglou, 2009). In addition, priming positive religious words such as faith and bless led to increased prosocial intentions (Pichon, Boccato & Saroglou, 2007). A recent review on religious priming indicated that different religious word primes also elicit different levels of prosocial behavior (Ritter & Preston, 2013).

However, several studies have consistently found that religiosity was associated with helping only those significant others and those who belong in the ingroup (Saroglou, 2006; Saroglou, Pichon, Trompette, Verschueren & Dernelle, 2005). An individual is considered aningroup when there is a set of shared similarities, values, and is part of one's psychological kin (Triandis, 1994). Studies of Batson consistently showed that religious people (in Batson's term, people with religious intrinsic orientation) engaged in prosocialbehaviors but only to those they perceive as similar to them and that their motivation for helping is egoistic (Batson, Denton & Vollmecke, 2008; Batson, Eidelman, Higley & Russell, 2001).

Interestingly, Malhotra (2010) found that willingness to help is more salient when an individual is able to attend religious services and most of these religious services occur on Sundays. He contended that this Sunday effect occurs because of the salience of religious norms to help those in need (see also Shariff & Norenzayan, 2007). Looking closely, the five dimensions of religion may provide an interesting insight so as to clarify this Sunday effect. Moreover, if this Sunday effect hypothesis does apply, then it is expected that the religiosity's public practice dimension may predict prosocial behavior towards outgroups.

Study Objectives. This study investigated the religiosity and prosocial behavior towards outgroup of a sample population. Specifically, it examined the predictive capacity of the five dimensions of religiosity (intellectual, ideology, public practice, private practice, and religious experience) towards prosocial behavior.

METHOD

The study utilized a correlational design. Specifically, a survey was conducted wherein respondents filled up a set of scales measuring their religiosityand prosocial behavior.

Most of the survey forms were distributed among college students in Cebu City, Philippines. There were a total of 212 respondents who participated in the

survey with 93 males (43.9%), 118 females (55.7%), and only 1 respondent (0.5%) did not indicate his/her biological sex. The mean age of the respondents was 18.98 years old (SD = 5.6 years).

The Centrality of Religiosity Scale (CRS, Huber & Huber, 2012) was used to measure the data. It is a 15-item scale measuring the five dimensions of religiosity. Responses are measured through a 5-point likert scale, with higher scores indicating high level of religiosity. Reliability value of each dimension ranged from .80 to .93, and for the whole CRS-15 is .92 to .96 (Huber, 2007). In the present study, total religiosity yielded strong reliability (α = .902) as well as intellectual dimension (α = .737), ideology dimension (α = .614), public practice (α = .781), private practice (α = .690), and religious experience (α = .801). CRS-15 was also correlated with religious identity and the importance of religion in daily life (Huber & Krech, 2009).

Vignettes on willingness to help. The dependent variable of the study was willingness to help. The researcher created 21 situations wherein anoutgroup needs help. Most of the situations the researcher created were based on the items of the altruism personality scale (Rushton, Chrisjohn & Fekken, 1981). The respondent rated his/her willingness to help by responding to a rating scale of 1 (not willing) to 4 (very willing). Higher mean score for these vignettes indicates more willingness to help. This researcher-made scale yielded strong reliability coefficient (α = .902).

After filling up the informed consent and the required demographics, respondents filled up the Centrality of Religiosity Scale (Huber & Huber, 2012) and questions regarding their willingness to help anoutgroup. After completing, debriefing was done either verbally or through referring the respondent to the contents of the informed consent. No deception was used in gathering the data. Incentives were given after completing the form.

RESULTS

The aim of the present study was to look into the predictive capacity of the five dimensions of religion in an individual's willingness to help anoutgroup.

Table 1 shows the mean and standard deviation of the respondents' prosocial behavior towards outgroup, their overall religiosity and its five dimensions. As shown, the prosocial behavior of the respondents are relatively high (M = 2.86, SD = .51). Based on the suggestion of Huber and Huber (2012), their overall religiosity was very high (M = 4.03, SD = .67), and the corresponding

dimensions were also high which include intellectual dimension (M = 3.62, SD = .82), ideology dimension (M = 4.21, SD = .76), public practice (M = 3.90, SD = .99), private practice (M = 4.47, SD = .69), and religious experience (M = 3.97, SD = .88).

Table 1. Mean and standard deviation of prosocial behavior towards outgroup, overall religiosity and its 5 dimensions (N = 212)

	M	SD
Prosocial behavior	2.86	.51
Overall Religiosity	4.03	.67
Intellectual	3.62	.82
Ideology	4.21	.76
Public Practice	3.90	.99
Private Practice	4.47	.69
Religious Exp.	3.97	.88

Multiple regression analysis was conducted to determine the predictive capacity of the 5 dimensions of religiosity towards prosocial behavioramong outgroups. Results suggest that the dimensions of religiosity significantly predict prosocial behavior, $F(5,206) = 4.07$, $p < .01$, $R^2 = .09$). However, only public practice (see table 2) showed significant coefficient value ($\beta = .265$, $t = 2.675$, $p = .008$), which indicates that only public practice predicts prosocial behavior towards outgroup. Thus, willingness to helpanoutgroup is more salient when a religious individual is practicing his/her faith with others, such attending mass, religious services, and the like. This is consistent with Malhotra's (2010) Sunday effect.

Table 2. Regression coefficients of the 5 dimensions of religiosity as predictors of prosocial behavior towards outgroups

	Unstandardized			Standardized	
	B	SE	β	t	Sig.
(Constant)	50.406	5.018		10.044	.0003
Intellectual Dimension	.351	.443	.080	.793	.429
Ideology Dimension	.417	.425	.088	.982	.327
Public Practice	.958	.358	.265	2.675	.008
Private Practice	-.670	.492	-.128	-1.362	.175
Religious Experience	-.137	.422	-.034	-.326	.745

DISCUSSION

It can be observed in an individual's everyday life that part of the decisions can belinked to religious reasons (Martos, Kezdy & Horvath-Szabo, 2011). Moreover, one of the dimensions of religious experience is the involvement in religious community (Marks, 2006). With these in mind, individual decisions and religious involvement may be reflective of the different dimensions of religion. Engaging in prosocialbehavior may thus be influenced by one's religiosity. In the present study, the aim was to look into the five dimensions of religion and its predictive capacity towards prosocialbehavior.

Results of the study indicated that among the five dimensions of religion, public practice significantly predicted prosocialbehavior towards outgroup. Participation in religious activities such as attending mass and religious services facilitate prosocialbehavior towards strangers or the outgroup in general. This indicates that most of the time individuals engage in prosocial behavior to people whom they have frequent contact with, specifically those within their religious community. This reflects what Saroglou (2006) called minimal prosociality. Minimal prosociality, based on the present result, occurs becauseengaging in public practice (e.g., going to mass and other religious services) facilitates prosocial behavior and most of the time the likely targets of this prosocial behavior are those individuals who were also engaging in the same public practice.Thus, a plausible explanation on why Saroglou (2006) found that religious prosociality is more leaning towards the ingroup is that most of the time religiosity is practiced within the religious community, and those people needing help are (as the situation

creates) those whom the individual has frequent contact with.

Another side of the coin may also suggest that because religious people are somehow stereotyped as prosocial people (Saroglou, Yzerbyt, & Kaschten, 2011), then it may also be plausible that those who need help approach the religious people or the religious institution in order to ask help; furthermore, it may be inevitable that those who ask help are those coming from the same religious community thereby creating the situation to help the ingroup.

More interestingly, the present study provides an insight that serves to complement Malhotra's (2010) Sunday effect. Malhotra (2010) contended that Sunday effect occurs because religious norms (i.e., part of religious norms is helping others) is being activated. An alternative explanation for Sunday effect is the idea that on Sundays, an individual's thought of a supernatural monitoring agent (Shariff & Norenzayan, 2007) after attending religious services is salient and thus acting prosocially is desirable. Based on the present study's result, an alternative explanation for Sunday effect is that the public practice dimension of religion is a facilitator of prosocial behavior. Put simply, engaging in religious services and the like influences an individual's willingness to help. Thus, even on other days, as long as the individual is participating in religious activities, heightened prosocial behavior may still be observed. Because the religious community imposes the idea that a religious individual has to help those in need and such social pressure is present in participation in religious activities, then that individual has to comply in order to avoid sanctions from the religious community (Johnson & Bering, 2006).

Because of its being institutionalized, several scholars view religion as putting borders to an individual's freedom (Pargament, 1997; Pargament, 1999; Zinnbauer, Pargament & Scott, 1999). Ironically, based on the results suggesting that public practice predicts prosocial behavior, it is also religion's being institutionalized which provides more opportunities for the religious indivudal to offer their help at least to those people in their religious community. One can imagine if these religious practices are done outside the same religious community and extended to those who need help, then religious prosociality is not only towards the ingroup members but also to those outgroups who are in need of help.

A few limitations of the study has to be noted. The respondents in the survey are young adults and different developmental stages may help clarify and further our understanding of the dynamics of religiosity and prosocial behavior. The study is correlational in nature and future studies may be able to establish causal link of religion and prosocial behavior through experiments. Lastly, it has to be noted that scholars also have varying definitions of religion (for review, see Hill, et al., 2000). Thus, results and inferences extracted from these varying

conceptualizations and measures may also vary. As Rusu and Turliuc (2011) suggested, a researcher needs to contextualize (and find fitting definition on this specific context) thedefinition of religiosity and its related constructs into the goals andpurpose of the study. Despite these limitations, the present study was able to further our understanding of religious prosocialitywhich is directed mostly towards ingroup and the dimension of religion (i.e., public practice) that may facilitate prosocial behavior.

Conclusion. Religion has an influence in different aspects of our lives (Ading, Seok, Hashmi, & Maakip, 2012). Partly because of religion's being institutionalized (Pargament, 1999), a common misconception is that it has been seen to be bad (Zinnbauer, Pargament & Scott, 1999). However, in the present study, it is religion's being institutionalized that optimizes the tendency of an individual to act in helpful ways. Thus, engaging in religious activities may not only benefit the individual but also those who need help.

REFERENCES

Ading, C.E., Seok. C.B., Hashmi, S.I. & Maakip, I. (2012). Religion and gender differences in stress, happiness and life satisfaction. Southeast Asia Psychology Journal, 1, 46-55.

Allport, G.W. (1966). The religious context of prejudice. Journal for the Scientific Study of Religion, 5, 447-457.

Bainbridge, W.S. (1989). The religious ecology of deviance. American Sociological Review, 54, 288-295.

Batson, C.D. (1976). Religion as prosocial: Agent or double agent? Journal for the Scientific Study of Religion, 15, 29-45.

Batson, C.D., Denton, D.M. & Vollmecke, J.T. (2008). Quest religion, anti-fundamentalism, and limited versus universal compassion. Journal for the Scientific Study of Religion, 47, 135-145.

Batson, C.D., Eidelman, S.H., Higley, S.L. & Russell, S.A. (2001). "And who is my neighbor?" II: Quest religion as a source of universal compassion. Journal for the Scientific Study of Religion, 40, 39-50.

Glock, C.Y. (1962). On the Study of Religious Commitment.Religious Education, (Special Issue), 98-110.

Hill, P.C., Pargament, K.I., Hood, R.W. Jr., McCullough, M.E., Swyers, J.P., Larson, D.B. & Zinnbauer, B.J. (2000). Conceptualizing religion and spirituality: Points of commonality, points of departure. Journal for the Theory of Social Behaviour, 30, 51-77.

Huber, S. (2007). Are religious beliefs relevant in daily life? In H. Streib (ed.), Religion inside and outside traditional institutions (pp.211 -230).Lieden: Brill Academic Publishers.

Huber, S. & Huber, O.W. (2012). The centrality of religiosity scale (CRS). Religions, 3, 710-724.

Huber, S. & Krech, V. (2009).The religious field between globalization and regionalization – comparative perspectives. In Bertelsmann-Stifftung (ed.), What the world believes: Analysis and commentary on the Religion Monitor 2008 (pp.53-93). Gutersloh: Verlag Bertelsmann-Stifttung.

Johnson, D.D. & Bering, J.M. (2006). Hand of God, mind of man: Punishment and cognition in the evolution of cooperation. Evolutionary Psychology, 4(1), 219-33.

Malhotra, D. (2010). "Sunday Effect" on pro-social behavior. Judgment and Decision Making, 5(2), 138-143.

Marks, L. (2006). Religion and relational health: An overview and conceptual model. Journal of Religion and Health, 45(4), 603-618.

Martos, T., Kézdy, A., & Horváth-Szabó, K. (2011). Religious motivations for everyday goals: Their religious context and potential consequences. Motivation and Emotion, 35(1), 75-88.

Pargament, K.I. (1997). The psychology of religion and coping: Theory, research, practice. New York: Guilford Press.

Pargament, K.I. (1999). The psychology of religion and spirituality? Yes and no. International Journal for the Psychology of Religion, 9, 3-16.

Pichon, I. & Saroglou, V. (2009). Religion and helping: Impact of target, thinking styles and just-world beliefs. Archive for the Psychology of Religion, 31, 215-236.

Pichon, I., Boccato, G. & Saroglou, V. (2007). Nonconscious influences of religion on prosociality: A priming study. European Journal of Social Psychology, 37, 1032-1045.

Preston, J.L., Ritter, R.S. & Hernandez, J.I. (2010). Principles of religious prosociality: A review and reformulation. Social and Personality Psychology Compass, 4, 574-590.

Preston, J.L., Salomon, E. & Ritter, R.S. (2013). Religious prosociality: Personal, cognitive, and social factors. In V. Saroglou (Ed.), Religion, Personality, and Social Behavior (pp.149-169). New York, NY: Psychology Press.

Ritter, R.S. & Preston, J.L. (2013). Representations of religious words: Insights for religious priming research. Journal for the Scientific Study of Religion, 52(3), 494-507.

Rushton, J.P., Chrisjohn, R.D. & Fekken, G.C. (1981). The altruistic personality and the self-report altruism scale. Personality and Individual Differences, 2, 293-302.

Rusu, P.P. & Turliuc, M.N. (2011). Ways of approaching religiosity in psychological research. The Journal of International Social Research, 4(18), 352-362.

Saroglou, V. (2006). Religion's role in prosocial behavior: Myth or reality? Psychology of Religion Newsletter: American Psychological Association Division, 36, 31, 1-8.

Saroglou, V. (2013). Religion, spirituality, and altruism. In K.I. Pargament, J.J. Exline, & Jones, J.W. (Eds.), APA Handbook of Psychology, Religion, and Spirituality (vol. 1): Context, theory, and research. APA handbooks in psychology, (pp. 439-457). Washington, DC: American Psychological Association.

Saroglou, V., Pichon, I., Trompette, L., Verschueren, M., & Dernelle, R. (2005). Prosocial behavior and religion: New evidence based on projective measures andpeer-ratings. Journal for the Scientific Study of Religion, 44, 323-348.

Saroglou, V., Yzerbyt, V. & Kaschten, C. (2011). Meta-stereotypes of groups with opposite religious views: Believers and non-believers. Journal of Community and Applied Social Psychology, 21, 484-498.

Shariff, A.F. & Norenzayan, A. (2007). God is watching you: Priming God concepts increases prosocial behavior in an anonymous economic game. Psychological Science, 18(9), 803-809.

Stark, R. & Glock, C.Y. (1968).American piety: The nature of religious commitment. Berkeley, Los Angeles.

Triandis, H.C. (1994). Culture and social behavior. New York: McGraw-Hill.

Wulff, D.M. (1997).Psychology of religion: Classic and contemporary (2nd ed.). New York: Wiley & Sons.

Zinnbauer, B.J., Pargament, K.I., & Scott, A.B. (1999). The emerging meanings of religiousness and spirituality: Problems and prospects. Journal of Personality, 67, 889-919.

Print ISSN 1656-0604
Online ISSN 2244-6532

Christian Moral Values, Prosocial Behavior and Involvement in Community Extension Program: Basis for Curricular Enhancement

Victoria Bantillo
University of the Immaculate Conception
Davao City, Philippines
Email: vbantillo@uic.edu.ph

ABSTRACT

Developing Christian moral values and making the students actively engage in community extension activities can be a challenge to the teachers and administrators. Thus, this study sought to determine the relationship between the Christian moral values and prosocial behavior of the students and their involvement in community extension activities. This study used a descriptive correlation research design involving 517 third year college students selected through stratified quota sampling technique from the nine member schools of the Davao Association of Catholic Schools (DACS)." The data revealed that the respondents' Christian moral values and prosocial behavior are significantly related to their involvement in community extension. Moreover, moral values and prosocial behavior are predictors of the student involvement in community extension.

KEYWORDS: Educational leadership, Christian moral values, prosocial behavior, community extension, Davao City, Philippines

INTRODUCTION

Teachers nowadays deal with the millennial learners who have been viewed differently be different experts. Eaton (n.d.) in her article "21 Characteristics of the 21st Century Learners" says that these millennial learners "want to have a say in their own education, ...collaborate amazingly well, ...increasingly aware of the world around them"; but Twenge (2012) opposes this by saying that today's young people are narcissistic and that "civic engagement is actually lower among the 1982-1999 born group they call millennials." These contradictory assessments among today's youth can pose a serious problem among teachers who may treat these learners the way they were taught in the past. Having lived in the age of digital information, these young people have different learning behaviors as well as aspirations in the future.

In the sectarian schools where students are educated not only for their personal development but for them to become an active and productive members of the community, the realities presented above can be a problem. It has to be noted that sectarian schools, like all other colleges and universities offer curricular and co-curricular activities in order to develop the students in a holistic manner. Sectarian schools exert every effort to provide a balance in the learners' physical, psycho-social, mental and spiritual development. And as their cutting-edge from the non-sectarian schools, they provide Theology subjects or religious studies in order to address the moral development of their learners.

It is rather unfortunate that these goals among sectarian colleges and universities are confronted by the bleak situation among today's young learners. As mentioned in the Global Nations news daily of Cebu, "APATHY or the young people's lack of care about social issues was ranked first among the problems faced by the youth today." This implies that the young people do not care about what happens in the world around them. This is affirmed by the literature review done by Lanuza (2003) who found out among his readings the study revealing the characteristics of the youth today as "impersonal and unmindful of external environment, individualistic, lacks emotional interaction."

This study is anchored on the Model of Reasoned Action (MORA) (Pryor & Pryor, 2005), the Communities of Practice Theory (Wenger-Trayner, 2014), and the theory on Prosocial Behavior (Batson, 1998; Carlo & Randall, 2002). These three theories speak of inducing behaviors or moral stance. Theology subjects or Religious Studies as used by other institutions are offered in order to mold the students into a person who is spiritually and morally responsible for himself or herself and for others. Religious Instruction as described by Lee

(1973) can be gleaned from the three lenses: the Intellectualist Position which holds that "the primary proximate purpose of religious instruction lies in the intellectual development of the learner in matters pertaining to religion;" the Moralist Position which "contends that the primary proximate purpose of religious instruction consists in making the student more virtuous," and the Integralist Position which "regards the primary purpose of religious instruction as the fusion in one's personal experience of Christianly understanding, action, and love coequally." Of this three lenses, the author is endorsing the Integralist Position.

The Community Extension Activities are designed to provide students avenues of applying or contextualizing the values. This is to engage the students into activities that awaken in them their social and moral responsibilities to his/her environment. This is one concrete way of implementing Harrison Elliot's (Moore, 1989) concept on Religious Education. Elliot (Moore, 1989) asserts that "the strong individualism that had been the hallmark of progressive education needed to be corrected with a social view of human life." The assessment of their prosocial behavior will then gauge whether the objectives of the two Independent Variables from the context of the academe have been achieved.

With this environment, the researcher who teaches Theology subject and is active in organizing community extension activities would like to know if the subject she teaches and the activities she had organized and implemented had indeed helped the students become more socially aware or empathetic of their neighbors.

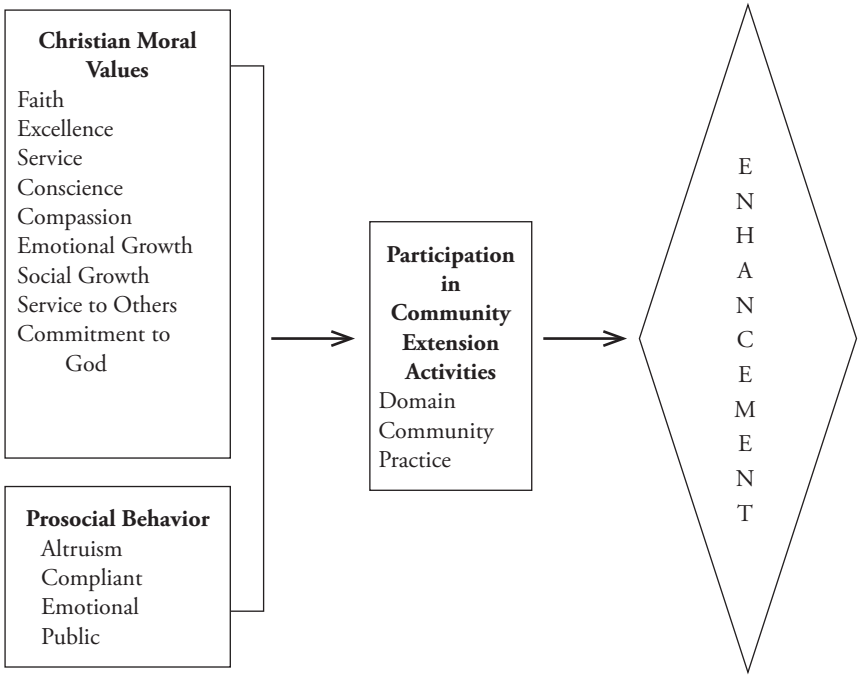

Figure 1. Conceptual paradigm

Study Objectives. This study sought to determine the relationship between Christian Moral Values, their participation in community extension activities and their prosocial behavior. Specifically, identify the level of Christian Moral Values of Students (Faith, Excellence, Service, Conscience, Compassion, Emotional Growth, Social Growth, Service to Others, and Commitment to God), the level of Pro-social Behavior (Altruism, Compliant, Emotional and Public) and the level of Involvement among Students in Community Extension Activities. Further, significance of relationship between Christian Moral Values and Community Involvement, and Pro-social Behavior and Community Involvement was sought. Finally, it sought to identify what influence the Community Extension Involvement of the student.

METHOD

This study utilized the quantitative research design particularly using the correlational method of analyzing data where two independent variables, namely Christian moral values and participation in community extension activities and one dependent variable which is the respondents' pro-social behavior.

This was done in the selected colleges and universities in Davao del Norte, Davao del Sur and the Davao Region's capital, Davao City. Purposive sampling was used wherein only third year college students of the DACS members schools, namely: Holy Cross of Davao College Icorporated, University of the Immaculate Conception, Assumption College of Davao, Assumption College of Nabunturan, St. Peter's College, Holy Cross College of Calinan, Holy Cross of Sasa Incorporated, Cor Jesu College of Digos City and St. Mary's College of Tagum City was included. The third year college students have been chosen because they have taken at least three Theology subjects and have stayed a considerable number of years in their school, thereby assumed to have participated in at least one community extension activity.

These students was selected through Stratified Random Sampling using the Slovin's Formula. As soon as the number of samples was identified, the respondents were selected through a lottery.

A researcher-made questionnaire was utilized composing of four parts: the respondents' demographic data, their Christian moral values and their participation in the community extension activities, and their level of Pro-social Behavior.

Frequency Count and Percentage was used on the students' demographic profile, weighted Mean for the respondents' level of attitude towards Theology subjects, participation in community extension programs and their pro-social behaviors. Moreover, t-test and ANOVA was used to determine the significance othe difference, pearson r to determine the significant relationship between the students' attitude towards Theology and their pro-social behavior; and between the students' participation in community extension programs and their pro-social behavior. Further, regression analysis to analyze the extent of influence of the independent variables to the dependent variables. Below are the matrices for interpretation:

Rating Scale for the Students' Attitude Towards Theology

Range	Verbal Description	Interpretation
3.51-4.00	Highly Favorable	The respondents have a very high regard to the content and activities of their Christian Moral Values.
2.50-3.50	Favorable	The respondents have positive perception to the content and activities of their Christian Moral Values.
1.50-2.50	Less Favorable	The respondents have low perception on the content and activities of their Christian Moral.
1.00-1.50	Not Favorable	The respondents are not convinced on the content and activities of their Christian Moral Values.

Rating Scale for the Students' Participation in Community Extension Activities

Range	Verbal Description	Interpretation
3.51-4.00	Very High	The students have voluntarily, faithfully and/or actively participated in all the Community Extension activities available for them.
2.50-3.50	High	The students have participated but have not necessarily actively engaged in all the Community Extension Activities available for them.
1.50-2.50	Low	The students participated and engaged only on Community Extension Activities that are required on them.
1.00-1.50	Very Low	The students do not often participate in Community Extension Activities available for them.

Rating Scale for Students' Pro-social Behavior

Range	Verbal Description	Interpretation
3.51-4.00	Very High	The respondents are highly altruistic and they automatically give help without thinking of a return benefit.
2.50-3.50	High	The respondents are highly empathetic but not necessarily altruistic.
1.50-2.50	Low	The respondent help other but not for altruistic reason.
1.00-1.50	Very Low	The respondents are not very empathetic to the other people in need.

RESULTS AND DISCUSSION

The level of the respondents' Christian moral values in this study is assessed by looking at the indicators: faithe, excellence, service, conscience, compassion, emotional growth, social growth, service to others and commitment to God.

Level of Christian Moral Values

Table 1 reveals that the moral values are always manifested by the students (4.16). Based on the table, faith got the highest mean (4.38), this implies that the schools was able to inculcate the value-faith. Thus, it is important for formators to nurture this moral value. In particular, the students manifest a high level of faith (4.38) through their prayerful communication with God for themselves, for others and for the world. It is interesting to note that while the respondents confess their belief in the Supreme Being, they do not necessarily manifest this in the rituals and practices observed by Christians. This is what Walaba and Kiboss (2013) says about the role of religious education in shaping the operation of the intellect that is providing more than just knowledge but actualizing this knowledge, like motivating the students to actively involved in religious processes and rituals.

In terms of excellence, the respondents are constantly working on making oneself better (4.08). The result suggests that the students generally do not settle for less. This is a positive attitude because by avoiding mediocrity, they somehow

show sense of responsibility for the outcome of their action and therefore are morally responsible for their actions. But, the respondents desire to keep improving their task is not coupled with the quest for knowledge on moral values through reading. Formators then can guide the students by providing materials or input that would open their mind on moral values.

Service is making oneself available for the needs of other people. Table 1, reveals, that the respondents have noticeable high level of service (3.93). This means that the students do not help others for recognition, that they make themselves available to anyone in need of understanding, encouragement and opportunities to improve life.

The respondents sense of responsibility and discernment to do what is right as well his/her ability to do what is morally right is high (4.12). This means that the respondents are responsible for their action, and their free will is used to help them fulfill their purpose in life.

For compassion, it is evident in the lives of the respondents that they can empathize to others (4.26). This is contrary to the description of Twenge (2012) that millennial are self-engrossed.

Further, the respondents' emotional maturity is high (4.27). This means that they believe that human beings are good, strong and happy, and they can be independent.

The respondents' social skills, their ability to relate with others and competent in dealing with personality differences is high (4.25). This means that they can balance their time with family, school and workplace. They also get along with friends that do not necessarily result into making them feel smart.

In terms of the respondents' service to others, the mean is high (4.02). This means that it is evident that they believe in helping others brings out the best in them and they save money from allowance for their reach out program.

Commitment to God, on the other hand, seeks to determine the respondents devotion to their God as manifested through their participation in the liturgical and para-liturgical activities. As revealed in table 1, commitment to God is high (4.13). This means that they communicate with God, reflects and believes that all things are possible because of God.

Table 1. Level of Christian moral values

Moral Values	Mean	Std. Deviation	Description
Faith	4.38	0.55	High
Excellence	4.08	0.56	High
Service	3.93	0.65	High
Conscience	4.12	0.60	High
Compassion	4.26	0.59	High
Emotional Growth	4.27	0.53	High
Social Growth	4.25	0.54	High
Service to Others	4.02	0.63	High
Commitment to God	4.13	0.68	High
Overall	**4.16**	**0.47**	**High**

Prosocial Behavior

Prosocial behavior refers to actions that are meant to help others, which includes altruism, compliant, emotional and public. As revealed in table 2, the respondents have a very high (3.09) prosocial behavior. Specifically, this means that the respondents give without expecting for a reward (3.37).

The respondents' compliant is very high (3.02). This means that they respond to the request of the people around them.

Emotional, on the other hand, got a very high mean (3.27). It implies that they help people close to them, and are easily moved by people who cry.

In terms of public (2.69), the students have more intrinsic motivation in helping others rather the extrinsic. They do not do good in order to impress the crowd, they still recognize the "others" as a opportunity to be of help.

Table 2. Level of prosocial behavior

Prosocial Behavior	Mean	Std. Deviation	Description
Altruism	3.37	0.39	Very High
Compliant	3.02	0.50	Very High
Emotional	3.27	0.50	Very High
Public	2.69	0.72	High
Overall	**3.09**	**0.38**	**Very High**

Level of Involvement in Community Extension

Involvement refers to the extent of the students' participation in a specific activity. As shown in table 3, the respondents level of involvement is very high (3.06). Specifically, in terms of domain (3.02), they do not participate in community extensions for the sake of rewards and recognition, however, they also do not take seriously community extension activities which does not benefit them.

The respondents take community involvement as an opportunity to get a shared learning experience-community (3.11). They find solidarity among their classmates not only during the activity but even if the activity is over. This affirms the study of Brennan, Barnett and Baugh (2007), that extension plays a vital role in engaging youth through interactions with the local community.

Practice is also very high (3.05). This means that they were taught of the role and responsibility in community extension and they also apply the insights gained from the activity.

Table 3. Level of involvement in community extension

Participation	Mean	Std. Deviation	Description
Domain	3.02	0.44	Very High
Community	3.11	0.45	Very High
Practice	3.05	0.44	Very High
Overall	**3.06**	**0.39**	**Very High**

Relationship of Moral Values and Prosocial Behavior to the Involvement of Students in the Community

The data in Table 4 shows the correlation of moral values and prosocial behavior to the involvement of students in the community. It can be gleaned in the results that moral values is significantly related to the community involvement of students as reflected by the p-value that is less than 0.05 and positive correlation coefficient, r=.471. This implies that the increase in moral values formation of the students would also likely increase their involvement in the community.

Similarly, the relationship between prosocial behavior and community involvement is found to be significant as evident by the p-value that is less than 0.05, and positive and moderate strength of correlation as shown by the correlation coefficient of .502. This means that the increase in the prosocial behavior of the students would also likely increase their involvement in the community.

Table 4. Relationship of enabling moral values and prosocial behavior to the involvement of students in the community

Independent Variables	Involvement of Students in the Community		Remarks
	R	p-value	
Moral Values	.471	.00	Significant
Prosocial Behavior	.502	.00	Significant

Influence of moral values and prosocial behavior on the involvement of students in the community

Table 5 presents the results of regression analysis which purpose is to show the significant predictors of involvement of students in the community. The results indicate that moral values and prosocial behavior were found to be significant predictors of teacher empowerment.

In particular, it shows the influence of moral values on community involvement has generated a p-value that is less than .05 and positive standardized beta value of .329. This denotes that the regression weight for moral values in the prediction of community involvement is significantly different from zero at the 0.05 level (two-tailed). Thus, for every unit increase in the moral values, there is a corresponding increase in the in the community involvement by .329. This implies that moral values formation contributes to the involvement of students in the community.

In the same way, the influence of prosocial behavior on the community involvement of students is found to be significant with a p-value that is less than 0.05 and positive standardized beta value of .379. This means that for every unit increase in prosocial behavior, there is a corresponding increase in the community involvement by .379. This finding suggests that prosocial behavior is a predictor of community involvement.

Lastly, the findings were apparent in the results of the regression analysis where 34.5 percent of the variance of community involvement were explained by the two independent variables as indicated by $R^2 = .345$. This means that 65.5 percent of the variation can be attributed to other factors aside from the two independent variables.

Table 5. Influence of moral values and prosocial behavior on the involvement of students in the community

	Model	Unstandardized Coefficients		Standardized Coefficients		p-value	Remarks
		B	Std. Error	Beta	T		
1	(Constant)	.723	.143	.329	5.057	.000	Significant
	Moral vaues	.272	.032	.379	8.570	.000	Significant
	Prosocial behavior	.391	.040		9.875	.000	

Note: R = .588, $R^2 = .345$, F-ratio = 136.436, P-value = .000

REFERENCES

Apathy is top problem of the youth. (November 11, 2010). Cebu Daily News. Retrieved on October 19, 2014 from http://globalnation.inquirer.net/cebudailynews/community/view/20101101-300873/Apathy-is-top-problem-of-the-youth

Batson, C.D. (1998). Altruism and prosocial behavior. In Gilbert, D. T., Fiske, S.T., and Lindzey, G. (eds.), The Handbook of Social Psychology (4th edn., Vol. 2). McGraw-Hill, Boston, MA, pp. 282-316.

Brennan, M.A, Barnett, R.V. & Baugh, E. (2007). Youth Involvement in Community Development: Implications and Possibilities for Extension. Journal of Education, vol. 45 no. 4, Retrieved from http://www.joe.org/joe/2007august/a3.php

Carlo, G. & Randall, B. (2002). "The Development of a Measure of Pro-social Behaviors for Late Adolescents." Faculty Publication, Department of Psychology, Paper 70. Retrieved on May 1, 2014 from: http://digitalcommons.unl.edu/psychfacpub/70

Eaton, S.H. (2011). 21 Characteristics of the 21st Century Learners. Retrieved on October 1, 2014 from http://drsaraheaton.wordpress.com/2011/12/07/21st-century-learners/

Lanuza, G. (2003). The Mediatization of Filipino Youth Culture: A Review of Literature. Global Media Journal, Vol. 2, No. 3. Retrieved October 1, 2014 from http://lass.purduecal.edu/cca/gmj/fa03/gmj-fa03-lanuza.htm

Lee, J.M. (1973). The flow of religious instruction. Birmingham, Alabama: Religious Education Press, Inc.

Moore, A. (1989). "A Social Theory of Religious Education" in Allan J. Moore, ed. Religious education as social transformation. Birmingham, Alabama: Religious Education Press, Inc.

Pyor, B.W. & Pyor, C.R. (2005). The school leader's guide to understanding attitude and influencing behavior. Thousand Oaks, California: Corwin Press.

Twenge, J.M. (March 26, 2012). The Narcissism Epidemic. Psychology Today. Retrieved on October 1, 2014 from http://www.psychologytoday.com/blog/the-narcissism-epidemic/201203/whats-wrong-youth-today

Walaba, A.A., & Kiboss, J.K. (2013). Factors influencing undergraduate students' choice of Christian religious education as a school teaching subject in Kenya. International journal of academic research and reflection, 1(3), 8-14.

Wenger-Trayner, E. Communities of Practice: A Brief Introduction. Retrieved on September 13, 2014 from http://wenger-trayner.com/theory/