CNU Journal of Higher Education
Volume 13 (2019), p 34-42

From Novice to Expert: The Lived Experience of Master Teachers in Science

John Robert D. General
Foundation University, Dumaguete City, the Philippines

Date Submitted: March 21, 2019
Date Revised: June 5, 2019

Originality: 91%
Plagiarism Detection: Passed

ABSTRACT

This study explored the lived experiences of Master Teachers to help bridge the teaching gap with the novice Science teachers. This phenomenological inquiry utilized a set of open-ended questions constructed based on Domain 1 of the Philippine Professional Standards for Teachers (PPST) and employed semi-structured interviews among seven purposively chosen participants. Data were recorded, transcribed and analyzed through Colaizzi's seven-step method. It revealed nine themes that are aligned to three of the seven domains of the PPST. It emphasized that to become master teachers, time, effort and hard work have to be invested by the novice Science teachers. Their lived experiences are considered intricate, unique and encompassing. Finally, it is recommended that the explored lived experiences through the PPST should be considered as a springboard data for DepEd administrators, co-teachers, stakeholders' community, and students to improve the teaching-learning process.

Keywords: *Lived Experience, Master Teachers, Master Teachers in Science*

INTRODUCTION

The role of the more experienced teachers in assisting the novice can never be underestimated. Master teachers are the experts of the curriculum and are the guide to the neophyte teachers. They demonstrate appropriate teaching-learning skills – a necessary tool towards holistic Science education that the novice teacher can emulate.

According to DeYoung (2009), teaching effectively comprises six major categories: competence, pedagogy, relationships, personality, evaluation and availability for students. These categories are guidelines for teachers to foster an ideal learning environment. As research has proven that a single style, technique or skill may enhance or impede learning, it is recommended that teachers must be skillful in modifying their art of teaching to best complete the requirements of teaching science in the classroom.

In the Philippines, the career ladder in teaching starts from being a classroom teacher or to become an officer in the higher office. These positions are granted to those who exemplify excellence in every facet of the teaching-learning experience and are offered with opportunities for promotion. A Master Teacher in the Department of Education is a permanent teacher position that carries various roles and responsibilities.

Several initiatives are in place to reform education from pre-service to actual teaching and the Philippine Professional Standards for Teachers (PPST) supplement these. It spells out quality pedagogy through well-defined domains, strands, and indicators that gauge learning, practice, and effective engagement. Further, these guidelines allow the teacher to realize what the acceptable norms for competent teaching are and how these can be utilized to improve learning outcomes.

The insights created, shared and imbibed from the Master Teachers are values worth emulating by the novice. They aid in the transmission of knowledge and skills. There are valued experiences that can be unraveled to explicitly help and support the learners. With the essential educational background and theoretical support, new faculty members are harnessed into becoming better and more effective facilitators of learning. However, such an assumption has not been proven in any exploratory qualitative research yet.

This research gathered significant insights and experiences of Master Teachers in Science. The gathered data were explored to help bridge the teaching gap between Master teachers in Science and the novice ones. This will allow the novice teachers to learn from the Master Teachers' lived experiences in improving teaching experience.

LITERATURE REVIEW

Teaching and Learning

From the crude practices in the past up to the most technologically advanced systems today teaching became the forefront of development. As defined by Bastable (2008), the process of education requires a step-by-step process that is sequential and logical, comprising mainly two inter-related operations which are teaching and learning. The process revolves around activities centered on the teacher and the learner within the learning situation. Although considered separate entities, together they plan and complete teaching-learning activities that will lead to actual learning – a change in behavior. When the behavior is changed, both the teacher and learner grow.

Further, Corpuz and Salandanan (2011) stated that there is a real interplay of the teacher and learner within the conducive learning environment. The absence of one makes the teaching-learning experience non-existent. A positive learning environment allows both teachers and learners to achieve desirable and precise learning outcomes or objectives.

There are several aspects to good teaching such as interpersonal, personal and professional, however, the best teacher employs something unique, and something that is truly individualized which is the teaching style. This style is more than what skills, techniques, and attributes commonly discussed in the literature. DeYoung (2009) considered style as a perfect mix of form and content. It springs from the teacher's personality and character. It is so distinctive that it does not just come from the intellectual characteristics of the teacher but essentially the personality. It is the style that makes good teachers into inspirational teachers.

Teachers carry different brands of teaching style. Traditional teaching is now being replaced with various techniques that illuminate differentiated instruction to cater to the varying needs of the learners; and the teacher needs to adapt (Gill, 2013).

Science Teaching

Recently, Science teachers are mandated to embed inquiry-based teaching and technology in their classrooms. This will make better strides in reforming science education, thus preparing the students to be well-equipped. (Guzey & Roehrig, 2016). Over the years, there have been wide reforms in science education especially in the integration of technology in teaching. This integration allows both the teachers and the students to utilize fully the available technology to aid in the teaching-learning process. (Settlage, Odom & Pedersen, 2016).

In the past years, Science teachers are both creators and users of technology. They are involved in the testing and consumption of such in various areas such as the laboratory, physical experiments, hands-on activities, field trips among others (Wallace, 2013).

However, research reveals that Filipino students do not fully maximize the use of technology as reflected in their low performance in Science. Among the factors identified are, quality teachers, the teaching-learning process, the school curriculum, instructional materials, and administrative support (Department of Science and Technology- Science Education Institute, 2006).

Levels of Professional Teaching Practice in the Philippines

Teachers undergo a lifetime process of developing skills and knowledge to master the teaching-learning process. Teaching echoes the needs, values, and aspirations of the society, sets out the standards of practice, addresses the needs of each student, and utilizes results of research to improve the practice.

A teacher can enjoy the promotion of ranks in the Department of Education based on the set qualification standards. A Teacher I can be promoted to after three years depending on performance, experience, outstanding accomplishments, education, training, psychosocial attributes and potential (Llego, 2016).

To be promoted to be a Master teacher one should be a permanent teacher who finished a 4-year degree program, obtained very satisfactory performance in the last 2 years has at least three years of experience and with a minimum of 25

points in leadership potential. All promotions depend on available vacant positions (Llego, 2016).

THEORETICAL FRAMEWORK

This research is anchored on Patricia Benner's From Novice to Expert Model. Benner as cited in Alligood & Tomey (2010) states that developing knowledge comprises extending practical knowledge (know-how) from theories and scientific observations into an existent "know-how" knowledge that is applied in the actual practice of a discipline. Over the years, the individual learns to integrate theoretical and clinical or practice knowledge. The individual becomes an expert when one tests and modifies principles in the actual practice. Under humanness, persons have embodied intelligence, that is, they come to know things by being in situations. When a person encounters a familiar situation, one recognizes meaning.

The levels of practice in this model include: (a) novice – the person involved has no background experience of the situation; (b) advanced beginner – the person can demonstrate marginally acceptable performance; (c) competent – this is typified by considerable conscious and deliberate planning that determines which aspects of current and future situations are important and which can be ignored; (d) proficient – the performer perceives the situation as a whole rather than in terms of aspects, and the performance is guided by maxims and (e) expert – the individual no longer relies on analytical principle (rule, guideline, maxims) to connect understanding of the situation to an appropriate action.

However, to contextualize Benner's Model in this study, the PPST is used. The PPSTwhich is built on NCBTS presents explicit standards for teachers to know, follow and imbibe to achieve competence to improve education in the country. The professional growth of teachers is arranged in a continuum process which is from basic to exemplary. Based on lifelong learning, the teacher can recognize these standards as significant frameworks to allow them to move from different levels. These guidelines will refine their practice overtime to help reform education. Each standard has sets of descriptors that describe the four career stages. These descriptors are the basis for teachers' preparation, development, and support. In this research, the focus is on career stages 2 and 3.

Career Stage 2 or Proficient Teachers (identified as Novice by Patricia Benner) are independent professionals in the application of skills that are important in the classrooms. Programs of teaching are focused on meeting curriculum and assessment and they display good skills in planning, implementing and managing.

Career Stage 3 or Highly Proficient Teachers (identified as Expert by Patricia Benner) are consistent in the teaching practice. These teachers are good performers and have a unique set of skills to maintain an excellent teaching-learning process. The focus is high on situation recognition, problem-solving and optimization of opportunities from their personal experiences. These teachers work closely with other teachers as these individuals are a good source of support through mentoring and tutoring. In this study, they are the Master Teachers in Science in various schools.

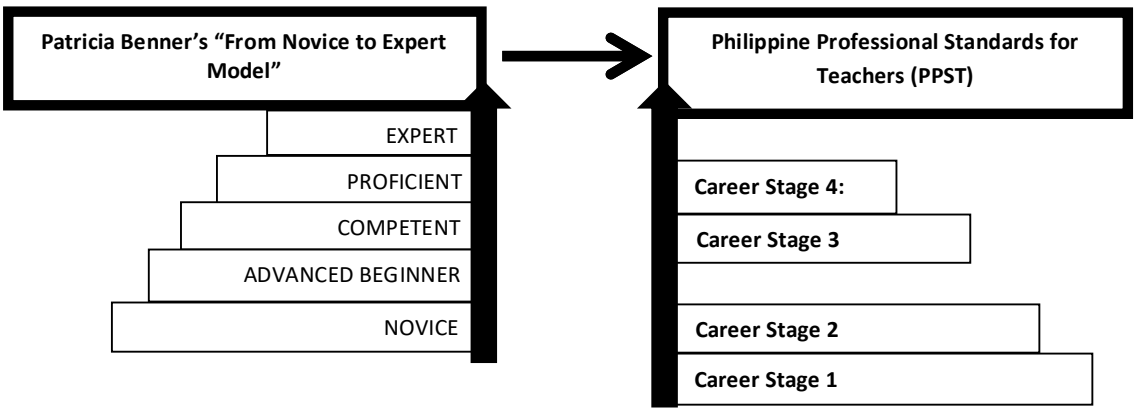

Figure 1. Theoretical Framework of the Study

METHODOLOGY

Research Design

The phenomenological Husserlian approach was used. Phenomenology understands and explores people's daily life experiences. To interpret these experiences, Colaizzi's method was used. For the research involved rigorous strategies for data collection and well-organized techniques for valid interpretations. Polit and Beck (2013) posit that phenomenology is characteristically exploratory and descriptive and the intention is to create not a generalization of findings but a deeper understanding of the experiences from the perspective of the study participants.

Participants

Participants (female, *n*=3; male, *n*=4) were selected purposively based on the inclusion criteria and the phenomenon being studied. The participants must be Master Teachers specializing in Science (Biology, Chemistry, Physics or General Science), have Civil Service Commission-approved Master Teacher positions in various public secondary schools in the Divisions of Dumaguete City and Negros Oriental, have been teaching in the Department of Education for at least 10 years without interruption, male or female, have ages ranges from 30 to 65 years old, are presently teaching, and are English-Cebuano bilinguals.

Instruments

Since the research is phenomenological in nature, the interview employed guide questions designed to extract significant statements relating to the lived experiences of the participants. These questions are open-ended, in English and are based on Domain 1 of PPST.

Data Collection

The interview was conducted in interview-appropriate places in school campuses mutually agreed upon by both the study participants and the researcher. These places include the teachers' respective classrooms and faculty lounges.

Data collection was conducted systematically from March to April 2018. Before the interview proper, a brief description of the study, its purpose and objectives were explained to each participant clearly. The participants were also asked to sign the informed consent form.

During the interview, clarifications of the thoughts of the participants, the use of prompts to direct discussion on imparting valuable information and the provision of signals to indicate that points were heard and understood, were given emphasis. The researcher ensured that audiotape recordings were transcribed within 48 hours after the interview. Then, the recordings and transcriptions were re-checked to ensure the accuracy of the transcription. Lastly, the participants were asked to sign an informed consent.

Data Analysis

As mentioned, Colaizzi's seven-step method was used in the study. With this the following steps are followed First, the researcher recorded all interviews in an audiotape device (cellular phone) and transcribed them verbatim. Second, significant statements or phrases were taken from the participants' transcripts pertaining directly to the research phenomenon. Third, formulated meanings were made from significant statements. Cornelia (2012) states that formulated meanings should faithfully reflect the intent of each statement. The third stage required conscientious bracketing that acknowledged any presuppositions; thus, misinterpretation of the participants' views was avoided.

Fourth, the formulated meanings were clustered into themes, which were consequently considered the emergent themes. These themes underwent constant counterchecking and refinement against the original transcripts to truly reflect the meaning of the experiences. Fifth, an exhaustive description of the lived experiences were made. This provided a comprehensive insight into the lived experiences of the Master teachers.

Sixth, the exhaustive description was validated by the participants themselves. Returning to the participants and conducting a possible further interview for validation ensured an accurate representation of their experiences. During the process, their comments were documented well. Lastly, if new data were presented by the participants after the validation, these were incorporated in the results.

Ethical Considerations

Prior to the commencement of the research process, the researcher adhered to the ethical protocols stipulated by the Ethics Committee of Negros Oriental State University. Consultations were conducted to ensure that the research topic is evidently sound, significant and ethically grounded. Throughout the whole interview process, the researcher guaranteed that a non-judgmental attitude was maintained to avoid censure. All participants were made to understand that joining in the study is voluntary. The information disclosed was treated with confidentiality and anonymity.

RESULTS AND DISCUSSION

This section presents the data gathered and analyzed through Colaizzi's method. The analysis was based on the transcripts of the seven participants. The data were collected from interviews with open-ended questions based on the three domains of the Philippine Professional Standards for Teachers (PPST): Domain 1 (Content Knowledge and Pedagogy), Domain 3 (Diversity of Learners), and Domain 4 (Personal Growth and Professional Development).

Table I presents the participants' profile in terms of age, sex, civil status, educational attainment, length of experience, division and years of experience being Master teachers in Science.

Table 1. Demographic Profile of the Participants

Demographic variable	%	*n*
Age		
25-40 years	14.3	1
41-60 years	71.4	5
60-65 years	14.3	1
Sex		
Male	57.1	4
Female	42.9	3
Civil Status		
Single	14.3	1
Married	85.7	6
Educational Attainment		
Bachelor's degree	14.3	1
Master's degree	85.7	6
Length of Experience		
Less than 10 years		
10-20 years	28.6	2
21-30 years	42.8	3
More than 31 years	28.6	2
Division		
Dumaguete City	42.9	3
Negros Oriental	57.1	4
Science Master Teacher years		
1-5 years	57.1	4
6-10 years	28.6	2
11-15 years	0	0
16-20 years	14.3	1

After a thorough analysis of the transcripts, the following nine (9) themes have emerged and these captured the lived experiences of the Master Teachers in Science:

Table 2. Emergent Themes of the Lived Experience of Master Teachers in Science based on PPST

PPST Strand	Description	Theme
Strand 1.1.1	Content knowledge and its application within and across curriculum areas	*Paddling through science specializations*
Strand 1.2.1	Research-based knowledge and principles of teaching and learning	*Experiencing dearth in research*
Strand 1.3.1	Positive use of ICT	*Technology in Plenitude*
Strand 3.1.1	Diversity of learners	*Different strokes for different folks*
Strand 3.1.1	Diversity of learners	*The real voyage of discovery*
Strand 1.6.1	Mother Tongue, Filipino, and English in teaching and learning	*English in the pedestal*
Strand 1.7.1	Classroom communication strategies	*Communication on a beam balance*
Strand 7.2.1	The dignity of teaching as a profession	*Leading through serving and collaborating*
Strand 7.4.1	Professional reflection and learning to improve practice	*With great power comes big responsibility*

Paddling through Science specializations.

Generally, the Master Teachers taught Science. Since the basic education curriculum is characteristically spiraling, the Junior High School teachers are tasked to handle classes at various levels. The Senior High School teachers, on the other hand, taught other subjects which were different from their specific field of expertise. These tasks caused the teachers many pressures, to offset these difficulties, self-study and solicited assistance from their co-teachers were established to deliver the assigned tasks well.

Science is everywhere. It is systematic and organized that knowledge is achieved through research and involves various specializations or

branches. According to Tan (2007), in the Philippines, the secondary Science education curriculum in the Philippines changed to yield practical knowledge that can be used by students in their everyday lives. These changes include the spiral curriculum that requires students to learn various branches of Science in the same year level. Teachers face these as opportunities for growth and a challenge.

In the Masters' curriculum, teachers are enrolled in various Science courses which equipped them to teach any field of Science. It is recommended, however, that the curriculum be specified to the specialization of teachers to ensure mastery in their field.

Experiencing dearth in research

The Master Teachers in Science were not involved in research conducted for promotional purposes. They participated in Learning Action Cell (LAC) sessions to discuss matters and issues concerning Science.

Research in Science education is important as results can be used for development. The aim of research in Science is to assist in social development, economic progress and protection of the environment (Khattari, 2009). Furthermore, Amerson and Strang (2015) argue that research should consider the uniqueness of the community as well as its culture. This is because some developments may be enhanced or hampered by the presence of varying cultural perspectives in both developing and developed countries.

Teachers in Science are encouraged to be engaged in research. The Masters' program could strengthen their capabilities to do so. Graduate students may engage in curriculum-related research. Masters of research that address recurring problems in the classroom, administration or community.

Technology in plenitude

Master Teacher's appropriated time and energy in utilizing ICT in the preparation, actual teaching, and evaluation of assigned Science subjects. These include, but are not limited to, the use of LCD projectors, TV, laptops, PowerPoint, social media (e.g. Facebook), and other software applications.

To better prepare students for the Science and Technology of the 21st century, the present Science education reforms require teachers to use technology and inquiry-based approach in their classrooms (Guzey & Roehrig, 2016). Science teachers are both creators and users of technology. They are involved in the testing and consumption of such in various areas such as the laboratory, physical experiments, hands-on activities, field trips among others (Wallace, 2013).

Al-Hariri and Al-Hattami (2017) reported a significant relationship between the academic performance of students in college and their use of technology. The devices most commonly used are laptops, phones, tablets, and desktop computers. There is a significant increase in academic achievement among students who use technology than those who do not.

However, caution should be employed when using technology in school. It should only be for academic purposes and should not disrupt learning in class. Attia, Baig, Marzouk, and Khan (2017) unraveled that the use of laptops and cellphones in the classroom has negative effects on the concentration of the students, as well as their ability to learn. Thus, the use of technology necessitates monitoring and improvement.

Different strokes for different folks

Master Teachers acknowledged individual differences among students, so their teaching strategies were diverse. They also recognized multiple intelligences, so their classroom activities were designed to cater for heterogeneous skills.

Effective teaching necessitates responsibility, creativity, and flexibility to create an environment for instruction that caters to the needs of the learners (Tulbure, 2011). Thus requires different teaching strategies in the classroom.

Teaching Science and Mathematics require varied teaching strategies to ensure success. When teachers consider the effects of multiple intelligences, and how these can be applied in their classrooms, learning is optimized. (Sulaiman, Abdurahman & Rahim, 2010).

Additionally, Ganyaupfu (2013) posits that effective learning happens when students are allowed to do tasks on their own instead of just providing information, i.e. lecture. Learner participation and reasoning among students are hampered when teachers do the talking most of the time. Students can comprehend better when engaged in performing tasks

and solve problems whatever the learning styles and interests may be.

The real voyage of discovery

Learning is best facilitated when teachers employ a discovery approach that allows the use of higher-order thinking skills, creativity, and critical thinking. Problem-solving is increasingly recognized as an important aspect of Science education, both as a means of facilitating learning and as an exercise in acquiring the skills of problem-solving itself (Garrett, 2008). In this strategy, both the students' and teachers' interests are maintained.

Furthermore, to facilitate the development of problem-solving, critical thinking and decision-making skills among students, teachers must be able to use various questioning strategies in the classroom (Scott et al, 2012). This talent can be learned and nurtured through constant practice by both the students and the teachers over time.

English on the pedestal

Despite DepEd's mandate that the Mother Tongue be used for classroom instruction, Master Teachers in Science still preferred English. They modeled English when speaking with their colleagues and also encouraged students to use the language. DepEd Order 16 series of 2012 stipulated guidelines on the implementation of mother tongue-based multilingual education, specifically in the Kindergarten and Grades 1-3 as part of the Basic Education Program. For Sciences in the higher levels, English remains to be the primary medium of instruction.

In the classroom, teachers need to speak English to facilitate better understanding. Teachers themselves should also be role models in utilizing the language.

The Masters' curriculum may be delivered generally in English. By doing so, the professors promote the use of the language and convey the idea that teachers may only shift to the vernacular when the need arises. When English is frequently utilized in graduate school, teacher-students will emulate them and use the language consistently in their classrooms.

Communication on a beam balance

The recognition of individual differences is an important matter. Subsequently, the master teacher in science should use verbal and non-verbal cues to address this. Both verbal and non-verbal communication skills are pre-requisites to effective classroom teaching. In Science, these two interplays so that whatever classroom activities are employed, meaningful communication is achieved.

Silverthorn (2006) fosters interactive communication in his teaching and outlined five steps to make this successful. The five steps are: create clear objectives, recognize essential content, resolve students' learning, utilize class time for practice and ungraded assessment, and ensure the match of graded assessment to class activities.

Leading through serving and collaborating

Several personality traits have been identified by Master Teachers to be of utmost importance in the service. These include leadership, collaboration, good interpersonal skills with colleagues, open communication and correct role modeling.

Teachers greatly impact learning and development and make a difference in the lives of students. Meador (2018) considered several personality traits that make teachers successful. Among them are determination and grit.

Determination is the ability to fight through adversity without surrendering a goal. Teachers who possess such traits are strong-willed and accomplish tasks at all costs. They persevere through the most difficult students. Grit, on the other hand, is the ability to be strong in spirit, courageous and brave. Teachers who possess this trait are creative. These individuals work hard and make difficult decisions.

The Masters' curriculum may need to focus on strategies that develop the affective domain of learning as well. Teachers may provide activities that allow students to be more collaborative, open-minded, competency-based, encouraged confident and professional.

With great power comes big responsibility

Master Teachers in Science recognized that they held greater responsibilities to both the students and their co-teachers. Personality traits and values related to fulfilling these responsibilities are perseverance, mastery of the content, trust, and leveling up of expectations.

According to Dugan (2013), a teacher should develop sensitivity in recognizing and understanding the needs of the students in the classroom, and as

adults in the community. To understand is to have emotional stability, appropriate self-projection, unselfishness, willingness to serve and deep concern for all especially the students.

Trust between the teachers and the students, families, and colleagues is important. It is based on reliability, kindness, openness, honesty, and competence to enrich confidence in teaching. In turn, it develops a sense of accountability for one's actions in the classroom.

CONCLUSION AND RECOMMENDATIONS

The lived experiences of Master Teachers in Science may help bridge the teaching gap between the novice and experts. The gathered themes may be used to help and support neophyte teachers in their current practice. The description of the nine themes that have emerged is presented to align in three of the seven domains of the PPST, which can be used as a guide in the modeling of appropriate knowledge and skills of Master Teachers by the novice.

Further, Master Teachers continue the best practices especially in the use of technology, diverse teaching-learning strategies, and verbal and non-verbal communication techniques. The upholding of the right values and attitudes are held as dear as teachers. These individuals employ higher-order, creative and critical thinking skills among students. Finally, the teachers devote time for research undertaking to improve and contribute to Science education

It is recommended that the lived experiences described become a springboard for future research involving other participants from different schools in the country. The results are used to inspire Science educators and stakeholders to continue best practices for a better teaching-learning process aided by the domains of the PPST.

ACKNOWLEDGEMENT

I wish to thank various people for their contribution to this research; Dr. Cesar Estrope, for his valuable technical support on this project; and Ms. Deborah Anne O. Rota, for sharing her expertise in qualitative content analysis. Special thanks should be given to Dr. Priscilla Sarabia-Cielo for editing skills. Finally, I wish to thank all the Master Teachers in Science of the Divisions of Dumaguete City and Negros Oriental for the willingness to join in the study.

REFERENCES

Al-Hariri, M. & Al-Hattami, A. (2017). Impact of students' use of technology on their learning achievements in physiology courses at the University of Dammam. *Journal of Taibah University Medical Sciences, 12*(1), 82-85. DOI: 10.1016/j.jtumed. 2016.07.004

Alligood, M. R. & Tomey, A. M. (2010). *Nursing theory (7th Ed.)*. Singapore: Elsevier Pte.

Amerson, R. M. & Strang, C. W. (2015). Addressing the challenges of conducting research in developing countries. *Journal of Nursing Scholarship, 47* (6), 584–591. DOI: [10.1111/jnu.12171]

Attia, N. A., Baig, L., Marzouk, Y, & Khan, A. (2017). The potential effect of technology and distractions on undergraduate students' concentration. *Pakistan Journal of Medical Sciences, 33*(4), 860-865. DOI:[10.12669/pjms.334.12560]

Bastable, S. B. (2008). *Nurse as educator: Principles of teaching and learning for nursing practice.* (3rd Ed.). Massachusetts, USA: Jones & Bartlett Publishers, LLC.

Cornelia, I. M. (2012). *The lived experience of post-stroke patients: Husserlian phenomenology and Colaizzi's method of data analysis.* Thesis from Dumaguete City: Philippines.

Corpuz, B. B. & Salandanan, G. G. (2011). *Principles of teaching 1. (2nd Ed.).* Manila: Lorimar Publishing, Inc.

Department of Science and Technology- Science Education Institute (2006). *Science framework for Philippine basic education.* Retrieved from http://www.sei.dost.gov.ph/images/downloads/publ/sei_scibasic.pdf

DeYoung, S. (2009). *Teaching strategies for nurse educators (2nd Ed.).* Singapore: Pearson Education, Inc.

Dugan, R. (2013*).* Personality and the effective teacher. *Journal of Teacher Education*, *12*(3). DOI: 10.1177/002248716101200314

Ganyaupfu, E. M. (2013). Teaching methods and students' academic performance. International *Journal of Humanities and Social Science Invention*, *9*, 29-35. Retrieved from http://www.ijh ssi.org/papers/v2 (9)/Version2/E0292029035.pdf

Garrett, R. M. (2008). Problem solving in science education. *Studies in Science Education*, *13*(1), 70-95. DOI: 10.1080/03057268608559931

Gill, E. (2013, January 5). *What is Your Teaching Style? 5 Effective Teaching Methods for Your Classroom* [Web log post]. Retrieved from https://education.cu-portland.edu/blog/classroom-resources/5-types-of-classroom-teaching-styles/

Guzey, S. & Roehrig, G. H. (2016). Teaching science with technology: Case studies of science teachers'

development of technology, pedagogy, and content knowledge. *Contemporary Issues in Technology and Teacher Education Journal*. Retrieved from http://www.citejournal.org/volume-9/issue-109/ science/teaching-science-with-technology-case-studies-of-science-teachersdevelopment-of-technology-pedagogy-and-content-knowledge

Khattari, S. (2009, January 19). Importance of research in science. *The Times of India*. Retrieved from https://timesofindia.indiatimes.com/home/education/news/Importance-of-research-inscience/articleshow/3999494.cms

Llego, M.A. (2016). *Criteria for master teacher*. Retrieved from https://www.teacherph.com /criteria-master-teacher/

Meador, D. (2018, March 22). *Personality traits that help Teachers and students succeed* [Web log post]. Retrieved from https://www.thoughtco.com/ personality-traits-that-help-teachers-students-3194422

Polit, D. F. & Beck, C. T. (2013). *Nursing research: Principles and methods (8th Ed.)*. USA: Lippincott Williams & Wilkins.

Silverthorn, D.U. (2006). Teaching and learning in the interactive classroom. *Advances in Physiology Education*, *30*(4). DOI: 10.1152/advan.00087.2006

Sulaiman, T., Abdurahman, A. & Rahim, S. (2010). Teaching strategies based on multiple intelligences theory among science and mathematics secondary school teachers. *Procedia - Social and Behavioral Sciences*, *8*, 512-518. DOI: 10.1016/j.sbspro.2010.12.070

Settlage, J., Odom, A. L. & Pedersen, J. E. (2016). Uses of technology by science education professors: Comparisons with teachers' uses and the current versus desired technology knowledge gap. *Contemporary Issues in Technology and Teacher Education.* Retrieved from http://www.citejournal.org/volume-4/issue-3-04/science/uses-of-technology-by-science–education-professors comparisons-with-teachers-uses-and-the-current-versusdesired-technology-knowledge-gap/

Tan, M. (2007). Towards relevance in science education: Philippine context. *International Journal of Science Education*, *10*(4). DOI: 10.1080/09 50069880100410

Tulbure, C. (2011). Learning styles, teaching strategies and academic achievement in higher education: A cross-sectional investigation. *Procedia - Social and Behavioral Sciences*, *33*, 398-402. DOI: 10.1016/j.sbspro.2012.01.151

Wallace, R.M. (2013). *Technology and science teaching: A new kind of knowledge*. Retrieved from https://msu.edu/course/cep/953/readings/WallaceTimeFinal.pdf