Canadian Journal of Educational and Social Studies
Vol. 5(5), 2025, pp.81-121

Self-efficacy and Proficiency of Freshmen Students to General Chemistry Course

Shereen Willie Paraguas[1]

[1] Teacher III/ Sta. Cruz Pingkian High School, Baan, Kayapa, Nueva Vizcaya, Philippines 3708
Email: shereen.paraguas@deped.gov.ph

DOI: 10.53103/cjess.v5i5.383

Abstract

This study sought to determine the level of self-efficacy and proficiency of college freshmen in a general chemistry course. This study was prompted by concerning reports on science education in the Philippines. For instance, the 2018 Programme for International Student Assessment (PISA) report from the OECD showed the Philippines scoring 357 in Science, ranking it second-to-last among participating countries. Similarly, the 2018 National Achievement Test for Grade 12 students revealed a "Low Mastery Level" with an overall Mean Percentage Score (MPS) of 31.94, which is significantly below the acceptable national standard of 75%. A descriptive correlational design was employed for this study. A descriptive part of the self-efficacy formative questionnaire assessed the relationship between the two (2) key self-efficacy factors: intellectual and educational self-efficacy. The level of proficiency of the respondents in a general chemistry course was also identified for the six (6) learning topics: atoms, molecules and ions, stoichiometry, gases, electronic structure of atoms, chemical equilibrium and acid-base equilibria, and salt equilibria. This study also correlated the level of self-efficacy and level of proficiency with a general chemistry course. The subjects of this study were 100 Information Technology students for school year 2019-2020 who took general chemistry (1 and 2) during their senior years. Results revealed that the respondents obtained an overall high self-efficacy level towards general chemistry. The results per learning topic revealed that only the scores of the students in atoms, molecules and ions and electronic structure of atoms had a significant relationship, while respondents' scores in stoichiometry, gases, chemical equilibrium, and acid-base equilibria and salt equilibria had no significant relationship to self-efficacy.

Keywords: Achievements, Challenges, Confidence, Performance, Strong Belief, Vision, Varied Activities

The Problem and Its Background

Rationale

As a foundational science, chemistry is at the core of modern industry. Much of the technology we enjoy today has its roots in this field. According to Magdara (2015), chemistry contributes in many ways to our economy, security, and technology, and it plays an important role in our lives. Achimugu (2016) notes that chemistry helps lessen poverty, increase employment, and provide medicine, clothing, and plastics.

However, the teaching of chemistry faces many challenges (Datukan, Espinosa & Orbe, 2018). The subject requires experienced and highly qualified teachers to help students understand and appreciate the lessons (Orbe, Espinosa, & Datukan, 2018). Unfortunately, the lack of laboratory experience among teachers and instructors is a significant problem (Soti & Mutch, 2011). Because of this, hands-on activities are not often performed during class.

Furthermore, a lack of textbooks, equipment, laboratory rooms, and chemicals in many schools hinders the effective teaching of chemistry (Orbe et al., 2018). This shortage of resources prevents the use of visual tools that are essential for explaining invisible, microscopic concepts. As a result, students struggle. Studies have shown that students face challenges with the comprehension of fundamental chemistry concepts (Barnea & Dori, 2000; Najike, 2004), and they often have poor comprehension in problem-solving (Auson, Cabigas, Garay, et al., 2019).

As an outcome, Adolfo (2017) said that they were bothered by decreased enrollment in science-related courses (including chemistry), due to its abstract nature and the need for focus. It also revealed that before the 21st century unfolded, (Osborne et al., 2003) students' interest in science, specifically in chemistry, had decreased. Many of the root causes of this difficulty lie in students' basic education on environmental factors. A number of students do not have the prerequisite knowledge expected from studying chemistry in high school. These students are not expected to do well in chemistry without extra work. For highly sequential topics in chemistry, students' foundations must be filled with the knowledge in order to understand the concepts (Ng, 2008).

Due to this situation, the Philippine education changed its Basic Education Curriculum (BEC) to the K-12 curriculum, and the chemistry subject became a part of the spiral progression. The spiral progression approach is one of the remedies to ease the difficulty of the chemistry subject (Kipnis and Hofstein, 2008), but lack of resources was a major challenge.

As we trace back from the recent results of Philippine global rankings in science education, it's very alarming that when the Philippines was compared to other ASEAN countries, it was almost behind. In terms of science education, the Philippines placed 112th among 139 countries in 2010 and 2011, and 115th out of 142 countries in 2011 to 2012 based on the Global Competitiveness Report. Furthermore, the Philippines also joined the Programme for International Student Assessment (PISA) of the Organization for Economic Co-operation and Development (OECD) last 2018. This program measures the ability to utilize reading, mathematics, and science knowledge and skills to meet real-life challenges. This is part of the Quality Basic Education reform plan and a step towards globalizing the quality of essential instruction in the Philippines. The results revealed that among 79 participating countries, the Philippines scored 357 in Science, ranking it second to the lowest. In the 2018 National Achievement Test results of grade 12, it also shows that the overall MPS in Science is 31.94, which falls under "Low Mastery Level". As against the national standard level, the result is below the national standard level of an acceptable MPS of 75%.

With these studies, the research explored the connection between a student's proficiency in chemistry and their self-efficacy. Even though this subject has become unpopular due to some negative trends and comments, (Auson, Cabigas, Garay, et al., 2019), (Jones & Leagon, 2014) stated that when someone has strong self-efficacy influenced by experiences, he/she will succeed despite failures. The same is true with Dalgety and Coll (2006); a positive outlook lessens negative thoughts, and students will be able to succeed and surpass the complications of the chemistry subject (Koballa & Glynn, 2007). Studies also demonstrated that learners with high self-efficacy in learning can achieve proficiency when studying challenging lessons (Chiou & Liang, 2012). Even (Hofer, 1994, as cited by Derillo, 2017) provides pure, realistic proof showing that students will succeed because they have high self-efficacy in learning chemistry concepts and are driven by an association between high motivation in learning chemistry (Lin et al., 2013).

Therefore, this research was conducted to determine the correlation between the level of self-efficacy and the level of student proficiency in general chemistry. The research focused on two key, interrelated factors, specifically educational and intellectual. Proficiency was measured by student scores on six specific learning topics, such as the following: (1) atoms, molecules, and ions, (2) stoichiometry, (3) gases, (4) electronic structure of atoms, (5) chemical equilibrium, and (6) acid-base equilibria and salt equilibria.

Statement of the Problem

This study aimed to assess the self-efficacy and proficiency of college freshmen in a General Chemistry course. Specifically, it sought to answer the following questions:

1. What is the college freshmen's self-efficacy level in general and in each of the following key factors?

    1.1 educational
    1.2 intellectual

2. What is the level of proficiency of freshmen in the given learning topics?

    2.1 Atoms, Molecules, and Ions
    2.2 Stoichiometry
    2.3 Gases
    2.4 Electronic structure of atoms

2.5 Chemical equilibrium

2.6 Acid-base equilibria and salt equilibria

3. Is there a significant correlation between the college freshmen's two (2) key factors of self-efficacy and their proficiencies to the six (6) learning topics in general chemistry course?

4. What supplementary learning package can be proposed to prepare college freshmen in taking General Chemistry Course?

Statement of Hypothesis

1. There is no significant correlation between college freshmen’s two (2) key factors of self-efficacy and their proficiencies in each of the six (6) General Chemistry learning topics.

Significance of the Study

This study's findings will be beneficial to the following:

Teachers/ College Instructors. The results and information of the study may serve as reference of the teachers so that they may be develop differentiated teaching strategies for making sure that all the students are provided with the opportunities.

Science Department Coordinators. This research can provide science department coordinators with a clearer understanding of students' level of self-efficacy and proficiency. This information can assist them in guiding chemistry teachers on instruction, curriculum delivery, and performance assessment..

Administrators. This study's findings may inform administrators about students' level of self-efficacy and proficiency, which can help them in developing policies and making decisions about the general chemistry curriculum. The results could also support the provision of comprehensive training and seminars for chemistry teachers on these key areas.

Future Researchers. The study’s result may inspire others to undertake self-efficacy and proficiency in other fields and places and in other aspects such as students learning styles and academic interests.

Scope and Delimitation

This study was conducted on freshmen students at a private institution in Nueva Vizcaya during the 2019-2020 school year. These students were enrolled in the Science Technology Engineering Mathematics (STEM) strand during their senior year and were currently taking a Bachelor of Science in Information Technology (BSIT).

The study focused on the freshmen students' level of self-efficacy, particularly with respect to two key factors which are educational and intellectual.

The specific learning topics of general chemistry addressed in this study were limited only to (1) Atoms, Molecules, and Ions, (2) Stoichiometry, (3) Gases, (4) Electronic structure of atoms, (5) Chemical equilibrium, and (6) Acid-base equilibria and salt equilibria.

Conceptual Framework

Chemistry is a foundational branch of science, and understanding its concepts is essential because they help us comprehend everything in our surroundings. Chemistry made us realize that everything became easy because of the inventions that were created to make life easier (Finnie & Meng, 2006).

However, chemistry is one of the hardest subjects being taught because of its theoretical concepts (Taber, 2002). Students could not give their full attention to chemistry when they do not appreciate its significance (Saldivar, 2015). And students have poor comprehension in word problems (Auson et al., 2019). Also, students find difficulty in solving problems in chemistry and lack of achievements reflects students have difficulties on concepts and completion of the problem (Tayaban, 2015).

Students with a strong sense of self-efficacy, developed through challenging experiences, social encouragement, and their own emotional states, are more likely to achieve success and reduce feelings of doubt. (Usher and Pajares,2008). Oluwatelure & Olorungtegbe (2010) said that a greater academic improvement can be achieved by students who have high proficiency. Rand Education, (2003), says while taking chemistry subject, they have high aspirations and make it into reality. And also, the students higher order thinking skills will eliminate their unproductive thoughts and that being proficient lead students acquire intense quest for knowledge (Huling, 2014).

The conceptual paradigm is presented in the figure below.

Conceptual Framework

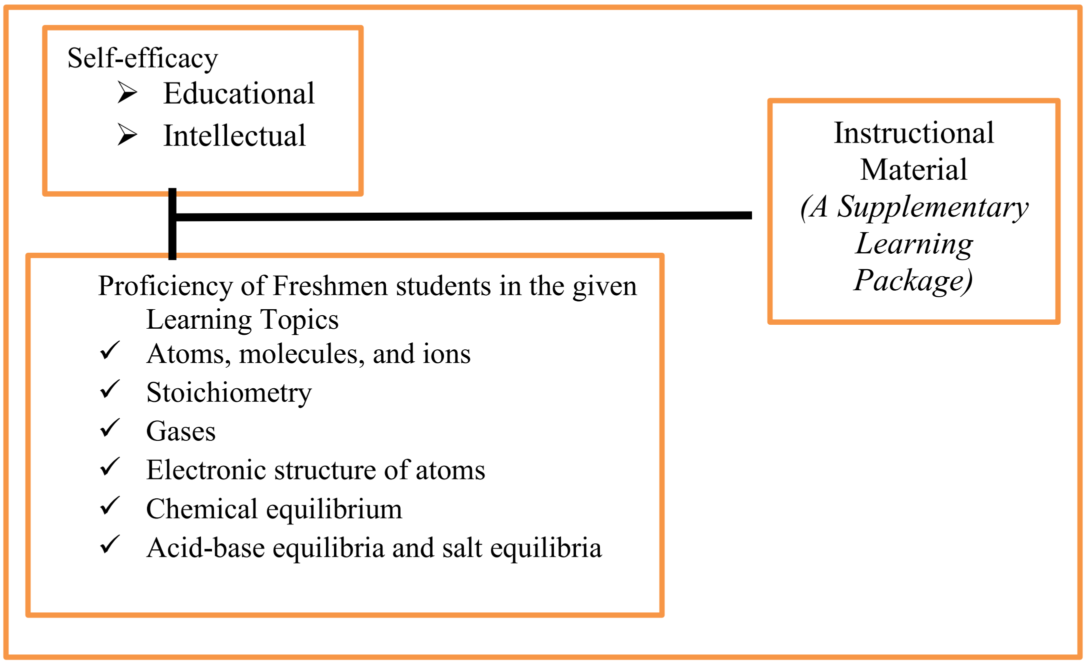

Figure 1: Research Paradigm

Figure 1 illustrates the study's flow. This research hypothesized that a learner's level of self-efficacy and proficiency could determine the type of instructional materials needed to supplement their needs in general chemistry.

Self-efficacy is defined as a person's belief in their own capabilities and is divided into two key factors: educational and intellectual. According to Bandura (2006), students who are pushed to their limits will have a high sense of self-efficacy. Proficiency, on the other hand, is the advancement of knowledge or an individual's ability to perform an extraordinary task (Ozowuba, 2018).

The outcome of this study is a supplementary learning package designed to meet the specific needs of these students.

Definition of Terms

For clarity, the following terms are defined both conceptually and operationally.

Self-efficacy- As conceptualized by Albert Bandura, self-efficacy is a person's belief in their capability to produce specific attainments and accomplish a given task (Yusuf & Muhammed, 2011). In this study, self-efficacy was divided into two factors, which were used to determine the level of students' beliefs and abilities in relation to general chemistry:

Educational Self-Efficacy, this factor refers to students' belief that they can finish homework assignments on time, maintain focus on school subjects during class, plan and organize their schoolwork, and effectively remember information presented to them.

Intellectual self-efficacy says that students believed that they cannot be easily discouraged when struggling and they were able to change the basic level. They also believe that they have the ability to face difficult tasks and overcomes challenges.

Proficiency- the advancement of knowledge or the ability of individual to perform an extraordinary task (Ozowuba,2018). Students who have vision and having criteria for success are likely those who can reach their goal in life (Moss & Brookhart, 2009). This study used achievement test to identify students' level of proficiency to general chemistry that was limited to six (6) learning topics.

The principles of general chemistry are fundamental and play a critical role in all aspects of our lives, from the economy and security to technology. This branch of science examines the structure, composition, and properties of substances at the atomic and molecular levels (Magdara, 2015).

Atoms, Molecules and Ions,
Stoichiometry,
Gases,
Electronic structure of atoms,
Chemical equilibrium, and
Acid-base equilibria and salt equilibria

Supplementary Learning Package – a supplementary learning package is an application of an instructional model for a specific learning objective, target group, and context. According to Koper (2003), it outlines the teaching-learning process and requires various activities for both learners and teachers to meet desired objectives. This package was the output of the study, based on a 60-item test mastery report. The results showed that nine objectives had a low mastery level, with correct responses from 100 BSIT freshmen of a private institution in Nueva Vizcaya ranging from 20% to 33%.

Review Related Literature and Studies

This part deals with the summary of major literature and studies that are interconnected with this present study. Striking points, either affirming or contradicting the present thesis, will be incorporated to provide comparison and contrast in the study.

Related Literature
Chemistry Education in the Philippines

The Philippines joined the Programme for International Student Assessment (PISA) of the Organization for Economic Co-operation and Development (OECD) in 2019. PISA measures the ability of students to apply their knowledge and skills in reading, mathematics, and science to real-life challenges. This is part of the country's Quality Basic Education reform plan, which aims to elevate the quality of essential instruction to a global standard.

In the 2018 PISA, the Philippines' 15-year-old students were among 79 participating countries and scored 357 in science, ranking them second to the lowest and below the average. The PISA study also evaluates proficiency based on performance levels, with Proficiency Level 2 considered a baseline by the OECD. The Philippines' average scores for 15-year-old students in science ranked at this level, indicating they are low performers with below-basic proficiency.

This low performance was also reflected in other global and national reports. The Global Competitiveness Report ranked the Philippines 112th out of 139 countries for science education in 2010 and 115th out of 142 countries from 2011 to 2012. Additionally, the overall Mean Percentage Score (MPS) for Grade 12 students in the 2018 National Achievement Test was 31.94, which falls under a "Low Mastery Level" and is significantly below the national standard of 75%.

In response to these results and the continuous deterioration of education quality, the Philippine government made significant revisions to its educational system. The Philippines was previously the only country in Southeast Asia and one of only three globally with a ten-year basic education program before university entry (SEAMEO INNOTECH, 2012). To address this, the Department of Education implemented the new K-12 Curriculum by virtue of Republic Act No. 10533, or the Enhanced Basic Education Law of 2013. The curriculum, which started in the 2012-2013 school year, institutionalized kindergarten and added two more years of high school (senior high school) to the basic education cycle. As stated by Laureano, Espinosa, and Avilla (2015), the goal of K-12 is to provide every learner with an enhanced and decongested curriculum that is recognized and internationally comparable.

The K-12 reform also brought major modifications to science subjects (Montebon, 2014). Under the Basic Education Curriculum (BEC) of 2002, chemistry was a year-long subject taught in the third year of high school (Orbe, Espinosa, & Datukan, 2018). With the new curriculum's spiral progression approach, chemistry is now taught for one quarter each year from Grade 7 to Grade 10, instead of a single year-round course.

In Grades 11 and 12, General Chemistry became a major subject within the academic STEM (Science, Technology, Engineering, and Mathematics) track. The

Department of Education provided a curriculum guide for General Chemistry 1 and 2 in December 2013, which was revised in August 2016. This guide contains 17 learning topics, including the six topics that were used in this study, which are:

(1) Matter and its Properties,
(2) Measurements,
(3) Atoms, Molecules, and Ions,
(4) Stoichiometry,
(5) Gases,
(6) Electronic structure of atoms,
(7) Electronic structure and Periodicity,
(8) Chemical bonding
(9) Organic Compounds,
(10) Intermolecular forces and liquids and solids,
(11) Physical properties of Solutions,
(12) Thermochemistry,
(13) Chemical Kinetics,
(14) Chemical Thermodynamics,
(15) Chemical Equilibrium,
(16) Acid-base Equilibria and salt equilibria,
and (17) Electrochemistry.

These learning topics must be deliberated within two (2) semesters. During the first (1st) semester:

(1) Matter and its Properties,
(2) Measurements,
(3) Atoms, Molecules, and Ions,
(4) Stoichiometry,
(5) Gases,
(6) Electronic structure of atoms,
(7) Electronic structure and Periodicity,
(8) Chemical bonding
(9) Organic Compound were the learning topics that needs to be discussed.

and in 2nd semester:

(1) Intermolecular forces and liquids and solids,
(2) Physical properties of Solutions,
(3) Thermochemistry,
(4) Chemical Kinetics,
(5) Chemical Thermodynamics,
(6) Chemical Equilibrium,
(7) Acid-base Equilibria and salt equilibria, and

(8) Electrochemistry, are the learning topics to be delivered among the students.

Chemistry Education Situation

The implementation of the K-12 curriculum, particularly the spiral progression approach for chemistry, has faced numerous challenges from various stakeholders within the Department of Education. According to de-Ramos-Samala (2017), a key problem is that students easily forget lessons from previous grade levels, which makes it difficult for them to connect concepts and for teachers to re-align competencies.

Datukan, Espinosa & Orbe (2018) also highlighted the challenges of teaching chemistry under this approach, noting the unavailability of textbooks and equipment to meet competency requirements. Many schools lack dedicated laboratory rooms, and there is a shortage of chemicals and laboratory equipment. A major issue is the limited laboratory experience of many teachers, as they may not be chemistry majors or graduates (Soti & Mutch, 2011). Because of the shortage of equipment, laboratory experiments are often left undone (Bergqvist et al., 2016), meaning hands-on activities are not performed during class (Barnea & Dori, 2000). While the spiral progression approach is intended to ease the difficulty of chemistry, Kipnis and Hofstein (2008) pointed out that a major challenge to its success is this lack of resources.

In light of these situations, a significant transformation was needed to adapt to the challenges. Teachers utilized all available school resources, providing students with teaching materials such as modules or worksheets to guide them through chemistry lessons (Ballen and Ospina, 2019). A lecture-style teaching method was primarily used to help students appreciate the concepts and problem-solving steps of each lesson (Nieswandt, 2007). Students were encouraged to memorize and recall important details and were given the chance to explore chemistry in their own ways, guided by the teacher.

Magdara (2015) established the appreciation that everything around us is a product of chemistry and that without it, products that make our lives easier would not exist. This guided students to think scientifically and logically. Even with the lack of actual laboratory experiments, they were at least able to relate to chemistry lessons (Ayas, Calik & Ozmen, 2009).

With the effective efforts of teachers and the support of the administration, chemistry was successfully delivered to and grasped by the students. Students understood that chemistry is an essential subject for everyone to learn (Magdara, 2015). Despite the hardships, students enjoyed working in small groups, which allowed them to make individual decisions about the learning process and resulted in very good scores (Eilks, 2005). They also helped each other to familiarize themselves with all the detailed concepts of chemistry (Hanson, 2016).

Self-efficacy

Self-efficacy, as defined by Albert Bandura, is a person's belief in their ability to perform a specific task (Aure & Jugar, 2017). It is widely recognized as a crucial part of human motivation and consequently influences the choices people make in their lives.

As an individual, self-efficacy increases the level of their capabilities to execute extraordinary outcomes in their chosen learning environment (Pintrich, 2002). Self-efficacy influences the individual to exert effort to succeed in attaining a possible outcome, and it promotes their persistence and strong fighting spirit to face setbacks (Lane & Lane, 2001).

Self-efficacy also helps individuals in self-regulating and monitoring their own behaviors, which are influenced by their past experiences, failures, and achievements (Jones & Leagon, 2014). It also increases positive thoughts and decreases negative outlooks. Positive experiences help in attaining goals, and no matter how tough the pathways are, there is no way to move back; just keep going (Dalgety & Coll, 2006). Self-efficacy also helps individuals discipline themselves to keep their visions focused (Linnenbrink & Pintrich, 2002), so that they will have the power to keep on fighting and marching on.

Educational and Intellectual Self-Efficacy

Gaumer & Noonan, (2018) adapted Bandura's self-efficacy measuring tools in socio-cognitive theory are the following and is divided into different areas of life.

(1) Family, which describes an individual's belief that their family trusts them and provides needed social and emotional support.

(2) Professional high personal, which refers to a person's satisfaction with their professional role or their capabilities as perceived by colleagues.

(3) Educational, which is a subject's satisfaction with the education they are receiving.

(4) Intellectual, which reflects a subject's satisfaction with their intellectual performance and the level of difficulty of their academic work.

In Educational Self-efficacy the following are some questions mostly asked:

(1) I finish my homework assignments by deadlines.
(2) I get myself to study when there are other interesting things to do.
(3) I always concentrate on school subjects during class.
(4) I take good notes during class instruction.
(5) I use the library to get information for class assignments.
(6) I plan my schoolwork for the day.
(7) I organize my schoolwork.
(8) I remember information presented well in class and textbooks.

According to Yazon (2015), educational self-efficacy refers to an individual's feelings about themselves and their self-esteem, both socially and academically. It also describes how they react to situations and manage difficult activities or responsibilities within a given time. Navarro and Santos (2013) stated that it is an individual's impression of their own proficiency in carrying out a certain duty. As Nasiriyan et al. (2011) affirmed, this drives individuals to believe they are capable. Al-Sowygh (2013) added that individuals with high self-efficacy are always attentive and can easily follow directions during discussions. Furthermore, educational self-efficacy helps individuals stay motivated and perform excellently to meet the given deadlines of their activities (Alyami, 2017).

Intellectual self-efficacy is a concept supported by several key findings. Nasiriyan et al. (2011) found that individuals will not easily be deterred by discouragement; instead, they will gain more strength from it to reach their goals. Moreover, intellectual self-efficacy inspires individuals to compete, which helps to further mold their capabilities and provides opportunities to gain new skills (Nasiriyan et al., 2011). Alyami (2017) explained that when given a task, expectations are often achieved when driven by inspiration and motivation from the people around them. Al-Sowygh (2013) also noted that this influences individuals to become more competitive and high-minded. As Bandura observed, a person's self-efficacy makes a difference in how they act and the decisions they make, which drives them to accomplish many things and achieve recognition. Ultimately, intellectual self-efficacy helps students access new information and the willingness to improve and accept challenges, leading to success (Jiang, 2011).

In this context, the following questions are often used to measure intellectual self-efficacy:

(1) When facing difficult tasks, I am certain that I will accomplish them.
(2) When I'm struggling to accomplish something difficult, I focus on my progress instead of feeling discouraged.
(3) I believe I can change my basic level of ability greatly.
(4) I believe I can successfully overcome many challenges that I will encounter in my studies.
(5) I believe I can express my opinion, even when my classmates disagree with me.
(6) In general, I think that I can obtain outcomes that are important to me.
(7) I can change my basic level of ability considerably.

Proficiency

Proficiency is a key component of success, describing both day-to-day interactions and more advanced skills. As Macasinag (2011) stated, it is crucial for academic performance and for providing access to scientific and technological discoveries. The more the brain functions, the more power it gains, which plays a significant role in an individual's critical and analytical thinking. Pellegrino (2013) added that proficiency is a concept that connects and interweaves science practices, cross-cutting concepts, and core content knowledge.

ACS Chemistry for Life defined proficiency as generic and transferable and lifelong process. Proficiency adapts to every situation and promotes new learning to new environment. It is very creative and resourceful therefore transformation is very indispensable (Miller,2016).

Proficiency is the mastery of different learning areas, thus the reflection of the quantity and quality of a student and is an essential feedback and it provides guidance and direction (August & Hakuta, 2005). O'Dwyer (2009) stated that proficiency is essential for a student's progress in both scientific and mathematical ability. This is evident through abstract and analytical knowledge seen in student assessments. Cummins (2000) also noted that proficiency includes the ability to transfer knowledge to others by sharing what has been learned and experienced.

One factor that affects the student's proficiency is the teacher's characteristics. Most students idolized teachers who are intelligent and talented in all aspects and specially on their field of specialization (Koopman et.al, 2017). The students study habits also provide evidence which determines their proficiency. Good study habits and positive attitude towards learning will enhance the process of learning particular skills including problem-solving and reasoning skills and it will also sharpen the ability and mastery of principles and constant application of what was learned (Alos et.al, 2015).

Another factor that affects student proficiency is technology. A computer with an internet connection can help students learn more about chemistry. For instance, teachers can use it to show topics that cannot be demonstrated in reality, such as the molecules in different phases of matter (solid, liquid, and gas) (Grosch & Rodrigo, 2013). As a required form of information and communication technology in the 21st century, the internet has brought about a revolutionary change in how information is accessed (Internet world stats, 2015).

A teacher's differentiated instruction can also boost student proficiency. According to Tomlinson (2011), this proactive teaching strategy is one of the methods that can engage all students in a classroom. When students are challenged and eager to learn, they become more motivated to grow, and what were once difficult tasks become easy for them (Chamberlin & Powers, 2010).

Related Studies

Self- Efficacy towards Proficiency in General Chemistry

A number of studies have confirmed that self-efficacy drives students to aim high (Safaria & Ahmad, 2013). Students with high self-efficacy tend to prefer difficult courses, such as chemistry, because they enjoy solving complex mathematical problems. This motivation to earn high grades also allows them to achieve outstanding academic performance in class (Koseoglu, 2015).

Mastery is also highly important for learning and requires patience. Findings show that students who are more confident and self-assured are more likely to attain higher levels of proficiency, which implies that self-efficacy beliefs play a significant role in predicting academic achievement (Koballa & Glynn, 2007). With this kind of preference, students develop their mathematical and theoretical abilities, improve their overall cognitive skills, and become proficient (Meece, Anderman, & Anderman, 2006). Proficient students are willing to accept additional assignments without hesitation. They view academic work as an opportunity to expand their knowledge, leading to new experiences and superior grades (Meece et al., 2006).

In chemistry lessons, students with high self-efficacy can remain focused, which helps them become proficient. Students can also be tutored in time-management and self-regulation techniques, especially since the subject is so complex (Villafane, Xu, & Raker, 2016). Research by Linnenbrink and Pintrich (2002) shows that students appreciate the value of goals, remain focused to attain mastery, and are encouraged to use self-regulatory methods when facing challenging responsibilities. Additionally, Judge et al. (2007) found that students strengthen their motivational beliefs when educators provide practical examples that relate lessons to real-life experiences, thereby clarifying and verifying concepts. Furthermore, providing feedback and comments makes discussions more engaging and attainable (Judge, Jackson, Shaw, Scott, & Rich, 2007).

In contrast, students with low self-efficacy often stop short of reaching their goals. Instead of persevering, they may quit and attempt a new, easier task (Meece, Anderman, & Anderman, 2006). Some students with lower self-efficacy do not embrace academic experiences because they feel they will not improve or succeed (Gonzales, 2018). They may even feel they will not pass a subject, which affects their overall performance (Koseoglu, 2015). As a result, their performance in chemistry is negatively impacted (Chi & Roscoem, 2002). This can also make them unable to comprehend lessons, leading to a feeling of being disengaged in the classroom (Usher & Pajares, 2008).

Overall, self-efficacy appears to be highly important in a student's learning process (Britner, 2008). It encourages the use of various strategies and resources to improve academic performance. As Usher & Pajares (2008) stated, students can work hard and achieve their desires when they are motivated and guided by others, such as teachers and instructors. With high self-efficacy, students can control their emotions and regain concentration when they are stressed or overworked due to numerous assignments (Pajares, 2006). Their aim for high grades becomes a source of inspiration, making academic discipline and emotional management indispensable (Meece, Anderman, & Anderman, 2006). In the long run, self-motivated students who can manage their emotions perform well academically without needing help from peers or instructors. They become proficient and are able to overcome their doubts (Finn & Frone, 2004).

Synthesis

The review of related literature and studies focused on the self-efficacy and proficiency of college freshmen in a general chemistry course. Previous studies have shown that the Philippines' performance in chemistry is below average compared to other nearby countries (Sanchez, 2019). Similarly, Baanu (2016) found that students' academic level in chemistry was very low, even though their self-efficacy was high. Additionally, Gonzales (2018) discovered no significant relationship between students' self-efficacy and their academic proficiency. These findings are analogous to the results of Madronio (2015) and Saldivar (2015), which also revealed a very low proficiency in chemistry among high school students in Nueva Vizcaya province.

Nevertheless, other studies have found different results. Auson, Cabigas, Garay, et al. (2019) found that general self-efficacy had a significant effect on student proficiency. Similarly, the study by Aure and Jugar (2017) showed a positive relationship between students' self-efficacy and their performance. Nalipay and Alfonso (2018) also found that self-efficacy and proficiency had a significant relationship. According to Lane and Lane (2001), students are able to attain positive outcomes due to their persistence, despite the difficulties of a subject.

The researcher continues to study these factors and results because although many studies have been conducted, this study is focused specifically on the general chemistry subject. The aim is to determine if studying general chemistry will have an effect on the two variables: self-efficacy and proficiency. While the studies on this topic are not endless, this research will contribute to the body of knowledge for future researchers.

After a series of research activities, this study determined that there is a significant correlation between self-efficacy and the proficiency of college freshmen in general chemistry. The study was very helpful because it provides comfort to students who often complain, showing that they may only lack confidence and trust in their abilities. Through this research, it was realized that anything is possible and that confidence and a fighting spirit are the only way to overcome every difficulty.

Research Methodology

Research Design

The study used a descriptive correlational design. The descriptive component determined the level of self-efficacy based on two key factors: educational and intellectual. The correlational component assessed the relationship between the respondents' level of self-efficacy and their proficiency in a college general chemistry course, as measured across six specific learning topics.

Research Environment

A pilot test was conducted at a premier CICM Catholic educational institution in Bayombong, Nueva Vizcaya. The campus is home to thousands of students, with large buildings and extensive grounds. The school is accredited by the Philippine Accrediting Association of Schools, Colleges, and Universities (PAASCU) and has been recognized by the Commission on Higher Education (CHED) as a Center of Excellence in Teacher Education, and a Center of Development in Civil Engineering and Information Technology. The institution offers numerous courses that cater to students' interests, including a K-12 Basic Education program, and employs a large number of compassionate and highly qualified teaching and non-teaching staff.

The final examination was held at a private institution in Bambang, Nueva Vizcaya, founded by a Korean missionary. The school is renowned for its criminology program, as its students have consistently achieved top ranks in the criminologist's licensure examination. It features large, Korean-style buildings and a wide campus where students can study and explore. The institution offers a limited number of courses tailored to 21st-century demands and a K-12 Basic Education program. It is also known for its brilliant, humble, and approachable faculty and staff.

Both institutions prioritized molding students in their Christian life.

Research Respondents

General Chemistry 1 was offered in the first semester, while General Chemistry 2 was offered in the second semester. Both Engineering and Information Technology are academic courses aligned with the STEM track.

Pilot testing was conducted with two sections of engineering freshmen from the College of Engineering, comprising ninety-six (96) students. The final testing was administered to one hundred (100) Information Technology freshmen who were also STEM strand graduates from the School Year 2019–2020.

Table 1: Respondent's gender and school attended during high school

		Gender		**Total**
		Male	**Female**	
School	**Public**	17	29	46
	Private	19	35	54
Total		36	64	100

Research Instrument

Two research instruments were used in this study, the first being a self-efficacy formative questionnaire composed of nine items adapted from Gaumer & Noonan (2018). The questionnaire underwent a reliability test, with an initial Cronbach's alpha of 0.788. A later internal reliability test of the scale yielded a Cronbach's alpha of 0.993, confirming the instrument's high reliability.

The questionnaire's items were divided into two parts: items 1-4 described the educational self-efficacy of the respondents, while items 5-9 described their intellectual self-efficacy. Respondents scored themselves on each item using a 5-point scale: 1 ("exactly not like me"), 2 ("not very like me"), 3 ("slightly like me"), 4 ("very like me"), and 5 ("exactly very like me"). The instrument's readability was tested using an online software tool (https://www.online-utility.org/english/readability_test_and_improve.jsp), which resulted in a Flesch-Kincaid Grade level of 9.5 and a Flesch Reading Ease Score of 56.65, indicating that it is understandable to an average Grade 10 student.

The second instrument was a proficiency test composed of 60 multiple-choice questions with four choices (A to D). It underwent a pilot test and a reliability test, receiving a Cronbach's alpha of 0.846. The content of the test was based on six learning topics from general chemistry, including Atoms, Molecules, and Ions; Stoichiometry; Gases; Electronic structure of atoms; Chemical equilibrium; and Acid-base equilibria and salt equilibria.

The test included 17 teacher-made questions aligned with the learning competencies given by the Department of Education, while 43 questions were adopted from the American Chemical Society Chemistry Olympiad Examination Task Force from 2000-2019. This instrument also underwent a readability test using an online software tool (https://www.online-utility.org/english/readability_test_and_improve.jsp), receiving a Flesch-Kincaid Grade level of 3.46 and a Flesch Reading Ease Score of 79.67, which means it is fairly easy for an average Grade 7 student to understand.

Data Gathering Procedure

A letter was secured, signed, and approved by the Dean's Office to conduct the study. The researcher personally administered both the pilot and final tests, explaining the purpose and content of the instruments to the respondents before distribution.

The researcher clarified that the study consisted of two parts: a formative questionnaire with nine items and an achievement test. During the pilot testing, the achievement test contained 100 items, but it was shortened to 60 questions for the final testing following revisions based on the DepEd Item Analysis Report.

The researcher instructed the respondents to complete the formative questionnaire in two minutes and the achievement test in sixty minutes. The timer began once all students had received the instruments. After an hour, the researcher collected the instruments, and the achievement test was checked manually.

Treatment of Data

The researchers used the Statistical Package for Social Sciences (SPSS) to analyze the data. Descriptive statistics, specifically the mean and standard deviation, were used to describe the self-efficacy levels of freshmen in the General Chemistry course. The self-efficacy score was calculated by adding the points from all nine items and then dividing by nine. Self-efficacy was scored on a 5-point scale, adapted from Garcia, Cheuang, and Abuyo (2015). A score of 1 represented the lowest level of self-efficacy, interpreted as "not like me," which indicated a lack of self-confidence and belief in long-term goals. Conversely, a score of 5 was the highest, interpreted as "exactly very like me," which reflected immense self-confidence and a strong belief in long-term goals.

Table 2: Reference scale for Self-efficacy

Range	Verbal scale	Verbal interpretation
4.50-5.00	**Very high** (exactly very like me)	**Extremely like me** (distinguished by immense self-confidence for long term and belief for long term goals)
3.50-4.49	**High** (very like me)	**Mostly like me** (distinguished by having high self-confidence and belief for long term goals but can slightly discouraged by setbacks)
2.50-3.49	**Average** (slightly like me)	**Somewhat like me** (distinguished by having an average self-confidence and belief for long term goals but can be discouraged by setbacks)
1.50- 2.49	**Poor** (not very like me)	**Not much like me** (distinguished by having low self-confidence and belief for long term goals and they can easily be discouraged by setbacks)
1.00-1.49	**Very poor** (exactly not like me)	**Not like me** (distinguished by having no self-confidence and no belief for long term goals)

Source: Garcia, Cheuang and Abuyo (2015)

To describe the students' level of proficiency, frequency and percentage distribution were used using descriptive table. The table below shows the reference scale used to determine the level of proficiency.

Table 3: The Range of Percent and Value Description of the Level of Proficiency

Range Percent	Value Description
84- 100 %	Advanced
76- 83.9 %	Proficient
68- 75.9 %	Approaching proficient
60- 67.9 %	Developing
Equal to or lower than 60 %	Beginning

Source: DepEd Order 8, s 2015

Presentation, Analysis, And Interpretation of Data

This chapter analyzes and interprets the collected data. It presents findings on the mean and standard deviation of the respondents' self-efficacy level, including its two key factors. The data also shows the frequency and percentage of their proficiency level in six learning topics. The final section of the chapter explores the correlation between self-efficacy and proficiency in the general chemistry course.

Section 1: Self-Efficacy
Level of self-efficacy

The table shows the over-all result on the level of self-efficacy with the two (2) key factors of the respondents.

.

Table 4: Over all Result of the Self-efficacy and to the two (2) key factors

Self-efficacy	N	Mean	Std. Deviation	Description
Educational	100	3.32	0.585	Average
Intellectual	100	3.67	0.599	High
Over all	100	3.51	0.540	High

The data presented in Table 4 shows an overall mean self-efficacy score of 3.51, which is qualitatively described as “high.” This indicates that the respondents' overall self-efficacy is very satisfactory, suggesting they have high self-confidence and a belief in achieving long-term goals, even if they can be slightly discouraged by setbacks. These findings align with the studies of Yaman Koseoglu (2015), Britner and Pajares (2001), and Merchant, Goetz, et al. (2012), which all suggest that high self-efficacy is linked to a strong belief and confidence in academic success, and that students eventually overcome setbacks.

Of the two key factors, intellectual self-efficacy has a mean of 3.67, which is also qualitatively described as “high.” This points to a very satisfactory level of intellectual self-efficacy among the respondents. In contrast, educational self-efficacy has a mean of 3.32, which is described as “average.” This result suggests that the respondents are more determined than they are contented with their current situation, a finding supported by the study of Gaumer & Noonan (2018).

Section 2: Proficiency of the Six (6) Learning Topics of General Chemistry Course

Table 5: The Table Presents the Proficiency Level of the Students in Atoms, Molecules and Ions

Learning Topic	Frequency	Percent	Description
	65	65.0	Beginning
Atoms, Molecules and Ions	18	18.0	Developing
	5	5.0	Approaching Proficient
	3	3.0	Proficient
	9	9.0	Advanced
Total	100	100.0	

Table 5 shows that 65 percent (n=65) of the respondents were at the beginner level for the topic of atoms, molecules, and ions. The remaining proficiency levels were distributed as follows: 18 percent (n=18) were developing, 5 percent (n=5) were approaching proficient, 3 percent (n=3) were proficient, and 9 percent (n=9) were advanced. Overall, the data indicates that most students are at the beginning level, which suggests that this topic is challenging and not easily comprehended.

These findings are similar to a study by Burila, et al. (2014), which found that students often just memorize concepts related to atoms, molecules, and ions without a deep understanding, leading to misuse of technical terms. This can place most students at the developing level. According to Orbe, Espinosa, and Datukan (2018), teaching these topics requires a more in-depth approach and closer supervision of students.

Therefore, when teaching atoms, molecules, and ions, teachers should help students understand the importance of the topic and encourage them to internalize the concepts and their applications.

Table 6: The Table Presents the Proficiency Level of the Students in Stoichiometry

Learning Topic	Frequency	Percent	Description
	52	52.0	Beginning
Stoichiometry	28	28.0	Developing
	12	12.0	Approaching Proficient
	8	8.0	Advanced
Total	100	100.0	

According to Table 6, 52 percent (n=52) of the respondents were at the beginner level for the topic of stoichiometry. The remaining respondents were at other proficiency levels: 28 percent (n=28) were developing, 12 percent (n=12) were approaching proficient, and 8 percent (n=8) were advanced. This data shows that most students are classified as beginners in this topic, which suggests that stoichiometry requires focused and extensive understanding.

These findings are consistent with studies by Boujaoude, et al. (2000) and Boujaoude, et al. (2003), who reported that students often lack comprehension of the procedures and concepts of stoichiometry because they are not engaged by problem-solving, which can lead to failing grades. Therefore, teachers should ensure that students grasp the procedures and fully understand the problems they are solving.

Table 7: The Table Presents the Proficiency Level of the Students in Gases

Learning Topic	Frequency	Percent	Description
	59	59.0	Beginning
Gases	19	19.0	Developing
	13	13.0	Proficient
	9	9.0	Advanced
Total	100	100.0	

Table 7 shows that 59 percent (n=59) of the respondents' proficiency level in the topic of gases was "beginning." The remaining students were at various other levels: 19 percent (n=19) were "developing," 13 percent (n=13) were "proficient," and 9 percent (n=9) were "advanced." This data leads to the conclusion that most learners are classified as beginners in this topic, suggesting that the study of gases in chemistry requires a strong grasp of the material.

These findings align with the research of Kousathana & Tsaparlis (2002), who found that students consider mathematical skills a very difficult part of the topic. The original text also noted that misconceptions can lead to errors that discourage students from repeating procedures. Probing is particularly challenging when the underlying problem concept is not understood. Hottecke (2000) similarly observed that many students dislike subjects that involve mathematics because they require significant intellectual focus.

Table 8: The Table Presents the Proficiency Level of the Students in Electronic Structure of Atoms

Learning Topic	Frequency	Percent	Description
	65	65.0	Beginning
Electronic Structure of Atoms	18	18.0	Developing
	9	9.0	Approaching Proficient
	8	8.0	Proficient
Total	100	100.0	100.0

According to the data in Table 8, a majority of the respondents had a beginner proficiency level in the topic of electronic structure of atoms, with 65 percent (n=65) falling into this category. The remaining students were distributed among other levels: 18 percent (n=18) were developing, 9 percent (n=9) were approaching proficient, and another 9 percent (n=9) were advanced. This data shows that most learners are classified as beginners in this topic, which suggests that the electronic structure of atoms is a challenging concept.

This difficulty is addressed by Bautista (2015), who argues that the topic should be taught in a way that helps students grasp the concepts despite the inherent difficulty. Additionally, Ferrell (2016) suggests that teachers should encourage students to explore these concepts through hands-on activities and individual explanations to improve their understanding.

Table 9: The Table Presents the Proficiency Level of the Students in Chemical Equilibrium

Learning Topic	Frequency	Percent	Description
	65	65.0	Beginning
Chemical Equilibrium	30	30.0	Approaching Proficient
	5	5.0	Advanced
Total	100	100.0	100.0

The data presented in Table 9 shows that 65 percent (n=65) of the respondents had a beginner-level proficiency in the topic of chemical equilibrium. The remaining students were distributed across higher proficiency levels: 30 percent (n=30) were "approaching proficient," and 5 percent (n=5) were "advanced." This indicates that the majority of learners were classified as beginners in this topic.

This result is consistent with a study by Bernal-Ballen, et al. (2019), which also found that chemical equilibrium is a very difficult topic in chemistry. The original text also noted that this topic involves both mathematical ability and conceptual understanding. Brawner (2011) suggests that chemical equilibrium is often not properly discussed due to limited time, which leaves students with an unclear understanding of its concepts. Therefore, teachers need to ensure they explain the lesson in a way that is accessible to their students.

Table 10: The Table Presents the Proficiency Level of the Students in Acid-Base Equilibria and Salt Equilibria

Learning Topic	Frequency	Percent	Description
	65	65.0	Beginning
	22	22.0	Developing
Acid-Base Equilibria and Salt	5	5.0	Approaching Proficient
Equilibria	6	6.0	Proficient
	2	2.0	Advanced
Total	100	100.0	

Table 10 reveals that 65 percent (n=65) of the respondents were at the beginner proficiency level for the topic of acid-base and salt equilibria. The remaining students were distributed among other levels: 22 percent (n=22) were developing, 5 percent (n=5) were approaching proficient, 6 percent (n=6) were proficient, and 2 percent (n=2) were advanced. This data indicates that the majority of learners are at a beginner level in these topics.

This finding is similar to a study by Nurisa and Arty (2018), who found that students have a very low understanding of these concepts due to a lack of practical application and performance of the lessons. Therefore, teachers must ensure that they correct misconceptions related to acid-base and salt equilibria and guide students through a step-by-step process, as suggested by Demircioglu, Ayas, and Demircioglu (2005).

Table 11: The Table Shows the Over-all Proficiency Level of the Six (6) Learning Topics

Over-All	Frequency	Percent	Description
	70	70.0	Beginning
Learning Topics	18	18.0	Developing
	8	8.0	Approaching Proficient
	4	4.0	Proficient
Total	100	100.0	100.0

Table 11 indicates that the overall proficiency level of the respondents is at the beginner stage, with 70 percent (n=70) classified as "beginning." The remaining students fell into other proficiency levels: 18 percent (n=18) were "developing," 8 percent (n=8) were "approaching proficient," and 4 percent (n=4) were "proficient." This data suggests that the students' overall proficiency level is low. As a result, teachers instructing chemistry need to be patient and employ various strategies to meet the diverse needs of their students.

This finding aligns with Kaskaya (2012), who states that understanding chemistry is challenging. It requires sufficient time, full attention, and a deep comprehension of the lessons.

Section 3: Correlation Between College Freshmen's Two (2) Key Factors of Self-Efficacy and Their Proficiencies towards General Chemistry Course

Table 14: The table shows the significant correlation of college freshmen's Educational Self-efficacy and their Proficiencies towards General Chemistry course

Learning topics	Educational Self-efficacy			Correlation
	N	Pearson Correlation	P-value	
Atoms, molecules and ions	100	0.237*	0.017	There is significant correlation
Stoichiometry	100	0.007	0.943	No significant correlation
Gases	100	0.024	0.816	No significant correlation
Electronic Structure of atoms	100	0.130	0.198	No significant correlation
Chemical Equilibrium	100	-0.033	0.741	No significant correlation
Acid-base equilibria and salt equilibria	100	0.144	0.152	No significant correlation
Over-All	100	0.130	0.199	No significant correlation

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

The table presents the correlation between college freshmen's educational self-efficacy and their proficiency in six learning topics: atoms, molecules and ions; stoichiometry; gases; electronic structure of atoms; chemical equilibrium; and acid-base and salt equilibria. The data shows no significant correlation between the respondents' scores on most topics and their educational self-efficacy at the 0.05 level. The only exception is the topic of atoms, molecules, and ions, which suggests that learners' proficiency in this specific topic is dependent on their educational self-efficacy. Overall, the findings indicate that a student's educational self-efficacy cannot generally predict their proficiency level in these topics.

This result is consistent with a study by Savec, Urankar, Aksela, et al. (2017), which found that students' educational self-efficacy cannot predict their proficiency in general chemistry. That study also mentioned that the lack of association could be due to factors such as teachers not being pure chemistry majors, which may prevent them from motivating students to learn more about the lessons. However, Antonio (2018) supports the claim that determination is directly linked to high-quality results. This aligns with Kaya, et al. (2011), who found that high self-confidence and the ability to relate atoms, molecules, and ions to real-world situations can also be influential.

Table 15: The table shows the significant correlation of college freshmen's Intellectual Self-efficacy and their Proficiencies towards General Chemistry course

Learning topics	**Intellectual self-efficacy**			**Correlation**
	N	Pearson Correlation	P-value	
Atoms, molecules and ions	100	0.351**	0.0001	There is significant correlation
Stoichiometry	100	0.056	0.577	No significant correlation
Gases	100	0.037	0.712	No significant correlation
Electronic Structure of an atom	100	0.245*	0.014	There is significant correlation
Chemical Equilibrium	100	0.141	0.160	No significant correlation
Acid-base equilibria and salt equilibria	100	0.80	0.426	No significant correlation
Over-All	100	0.207*	0.039	There is significant correlation

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*

The table presents the correlation between college freshmen's intellectual self-efficacy and their proficiency in six learning topics: atoms, molecules and ions; stoichiometry; gases; electronic structure of atoms; chemical equilibrium; and acid-base and salt equilibria.

The data reveals a significant correlation between intellectual self-efficacy and students' scores in atoms, molecules and ions ($r=0.351$, $p<0.01$) and electronic structure of atoms ($r=0.245$, $p<0.05$). This suggests that intellectual self-efficacy influences a learner's proficiency in these specific topics.

However, the level of proficiency in the other topics—stoichiometry, gases, chemical equilibrium, and acid-base and salt equilibria—was found to be not dependent on the students' intellectual self-efficacy.

Overall, the findings indicate that a learner's proficiency in general chemistry is reliant on their intellectual self-efficacy. This is supported by the rejection of the null hypothesis, as the overall computed r-value was 0.207 with a p-value of 0.039.

These results align with a study by Cheung (2011), which states that an in-depth knowledge of chemistry is highly valuable. The study also notes that real-life experiences are crucial for learning and that lessons should connect to students' daily routines. According to Koballa and Glynn (2007), a positive attitude and interest in the subject are also key factors for achieving satisfactory or outstanding results.

Section 4: Proposed Supplementary Instructional Materials

Based on the result of the study, a supplementary learning package (see appendix A) was created and hereby proposed to improve the level of self-efficacy and proficiency towards general chemistry. This supplementary learning package was validated by Mrs. Gliceria A. Marzan, RCh, MAT and Elsa L. Cajucom, PhD.

General Chemistry six (6) learning topics was utilized in this study and it came out that there are nine (9) competencies gained the low mastery level among the three learning topics which are:

1. competency in electronic structure of atoms,
   - describe the quantum mechanical model of the atom **STEM_GC11ES-IIa-b-52**
2. competencies in chemical equilibrium, and
   - describe reversible reactions **STEM_GC11CE-IVb-e-144**
   - explain the significance of the value of the equilibrium constant **STEM_GC11CE-IVb-e-147**
3. competencies in acid-base equilibria and salt equilibria.
   - define Bronsted acids and bases **STEM_GC11AB-IVf-g-153**
   - discuss the acid-base property of water **STEM_GC11AB-IVf-g-154**
   - calculate pH from the concentration of hydrogen ion or hydroxide ions in aqueous solutions **STEM_GC11AB-IVf-g-156**
   - determine the pH of a solution of weak acid or weak base **STEM_GC11AB-IVf-g-158**
   - explain the Common Ion Effect **STEM_GC11AB-IVf-g-159**
   - describe how a buffer solution maintains its pH **STEM_GC11AB-IVf-g-160**

Using the DepEd Mastery Level Report to determine students' mastery levels, the researcher created a supplementary learning package. This package focuses on nine specific learning topics to address students' needs by expanding their knowledge on key competencies. It was also contextualized and localized to suit the students of that specific area.

The learning package's readability was assessed using an online tool, resulting in a Flesch-Kincaid Grade level of 9.54 and a Flesch Reading Ease Score of 56.42. These scores indicate that the material is fairly difficult but can be understood by students at a Grade 10 level.

Summary, Conclusion, And Recommendations

This final chapter provides a summary of the study's findings and conclusions, followed by recommendations for future research.

Summary of the Findings

1. Self-efficacy with two (2) key factors:

over-all self-efficacy level to General Chemistry is “high”,
the student’s educational self-efficacy level of students is to General Chemistry is “average”, and intellectual self-efficacy level of students is to General Chemistry is also “high”.

2. The proficiency level of the students is measured in the following six (6) learning topics. Findings showed the six (6) learning topics displayed the following results:

“65 percent (n=65) of the respondents’ level of proficiency in learning the topic of atoms, molecules, and ions.”,

“52 percent (n=52) of the respondents’ level of proficiency in learning the topic of stoichiometry.”,

“59 percent (n=59) of the respondents’ level of proficiency in learning the topic of gases.”,

“65 percent (n=65) of the respondents’ level of proficiency in learning the topic of electronic structure of atoms.”,

“65 percent (n=65) of the respondents’ level of proficiency in learning the topic of chemical equilibrium.”, and

“65 percent (n=65) of the respondents’ level of proficiency in learning the topic of acid-base equilibria and salt equilibria.”

3. In correlation between self-efficacy with two (2) key factors and proficiency in six (6) learning topics;

(1) the scores of the respondents in atoms, molecules and ions recommend the rejection of the null hypothesis at 0.05 level of significance to educational self-efficacy while it is suggested to accept the null hypothesis at 0.05 level of significance on the scores of the respondents in stoichiometry, gases, electronic structure of atoms, chemical equilibrium, and acid-base equilibria and salt equilibria.

(2) the scores of the respondents in atoms, molecules and ions and electronic structure of atoms suggest the rejection of the null hypothesis at 0.05 level of significance to their intellectual self-efficacy, while it is recommended to accept the null hypothesis at 0.05 level of significance on the scores of the respondents in stoichiometry, gases, chemical equilibrium, and acid-base equilibria and salt equilibria.

Conclusion

Based on the study's findings, the following conclusions were drawn:

1. On average, students demonstrated a high level of overall self-efficacy, indicating they believe in their ability to perform well in general chemistry.

2. The overall proficiency level of the respondents was in the "beginning" range,

which suggests that students did not achieve passing scores in the six learning topics of general chemistry.

3. The study concluded that a student's educational self-efficacy does not determine their proficiency level across the six learning topics.

4. In contrast, a student's intellectual self-efficacy is a key factor in determining their proficiency in the six general chemistry topics.

Recommendations

Based on the study's findings and conclusions, the following recommendations are provided:

1. For Teachers and Instructors: To make the learning process more effective, teachers should be mindful of students' attitudes and ensure they are actively involved in discussions, giving them opportunities to express their opinions. Providing challenging tasks can help students build confidence in their ability to succeed. Additionally, connecting general chemistry concepts to real-life situations will help students better visualize and understand the material.
2. For Administrators: Administrators should support teachers in implementing the curriculum by allowing them to attend seminars and workshops. This will enhance teachers' knowledge and skills in accommodating students' needs, enabling them to better elaborate on lessons in the classroom and help students gain more information. Creating an environment that supports long-term goal-setting will also provide students with a lifelong tool for success.
3. For Future Researchers: It is recommended that future researchers continue this study by examining other factors, such as students' profiles, interests, and learning preferences. This could provide further insights into how to help students improve their perspective toward success, even when facing challenges.

References

Abubakar, R. B., & Eze, F. B. (2010). Female students' academic performance in mathematics at Federal College of Education (Technical), Omoku, Rivers State. *International Journal of Social and Policy Issues 6(1-2), 48-53.*

Achimugu, L (2016) Senior secondary school chemistry teachers perception of the factors effecting the effective utilization of ICT in teaching and learning chemistry. *International Journal of Scientific & Engineering Research, 7(10), 1906. http://www.ijser.org*

Aksela, M., & Lundell, J. (2008). Computer-based molecular modeling: Finnish school teachers' experiences and views. *Chemistry Education Research and Practice*, *9, 301–308.*

Al-Sowygh, H. Z., (2013). Academic distress, perceived stress and coping strategies among dental students in Saudi Arabia. *National Library of Medicine*

Alyami, M., Melyani, Z., Al Johani A., & Ullah E., (2017) The impact of self-esteem, academic self-efficacy and perceived stress on academic performance: A cross-sectional study of Saudi Phycology students. *ResearchGate. doi: 10.19044/ejes.v4n03a5*

Alos, S., Carranto, L., & David, J.J. (2015). *Factors affecting the academic performance of student nurses of BSU.* Unpublished Thesis. Benguet State University, La Trinidad, Benguet

Antonio, S. Jr. (2018) *Child and Adolescent Development*. Quezon City, Philippines: Rex Bookstore, Inc.

Aure, MRK. L., & Jugar, R.R., (2017). A Cross-sectional study on the self-efficacy of preservice science and mathematics teachers in a Philippine state university. *Annals of Tropical Research, 39(1), 135-146.*

Auson, KG. C., Cabigas, MR. B., Garay, RJ. B., Javier, CNL. A., & Ferrer, R.C., (2019). Student self-efficacy in modular accounting: a tool to improve the academic performance of accounting students enrolled in the modular program of De La Salle University. *International Journal of Engineering and Advanced Technology, 8(6S).*

Ayas, A., Calik, M., & Ozmen. (2009). A review of solution chemistry studies: Insights into students' conceptions. *Journal of Science Education and Technology, 14*(1), 29-50.

Aydin, Y. C. & Uzuntiryaki, E. (2009). Development and psychometric evaluation of the high school chemistry self-efficacy scale. *Educational and Psychological Measurement, 69(5), 868-880. doi:10.1177/0013164409332213*

Ayen, R (2014). *The Employability Skills of Teacher Education Graduates*. Unpublished Thesis. Kalinga-Apayao State College.

Baanu T., Oyelekan O., & Olorundare A. (2016). Self-efficacy and chemistry students' academic achievement in senior secondary schools in North-Central Nigeria. *The Malaysian Online Journal of Educational Science, 4.*

Baguio, S S. M., (2017). Breaking through general chemistry 2 for senior high school. Quezon City, C& E Publishing, Inc.

Bandura, A. (2006). Guide for constructing self-efficacy scales. *Self-Efficacy Beliefs of Adolescents*, 307–337.

Bandura, A. (2006). Guide for constructing self-efficacy scales. In F. Pajares & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents* (pp. 307-337). Greenwich, CT: Information Age Publishing.

Barak, M., Ashkar, T., & Dori, Y. (2011). Learning science via animated movies: its effect on student's thinking and motivation. *Computers & Education, 56 (3),* *839–846.*

Barnea, N., & Dori, Y. J., (2000). Computerized molecular modeling- the new technology for enhancing model perception among chemistry educators and learners. *Research and practice in Europe, 1 (1)*, 109–120.

Bautista, R. (2015). Optimizing classroom instruction through self-paced learning prototype. *Journal of Technology and Science Education.*

Bergqvist A., Drechsler M., De Jong O., & Rundgren S. C., (2013), Representations of chemical bonding models in school textbooks– help or hindrance for understanding? *Chem. Educ. Res. Pract., 14(4), 589–606, DOI: 10.1039/C3RP20159G.*

Bergqvist A., Drechsler M., & Chang Rundgren S., (2016). Upper secondary teachers' knowledge for teaching chemical bonding models. *Int. J. Sci. Educ., 38(2), 298–318, DOI: 10.1080/09500693.2015.1125034.*

Bernal-Ballen, A., & Ladino-Ospina, Y., (2019). Assessment: a suggested strategy for learning chemical equilibrium. *Education Sciences, 9, 174; doi:10.3390/educsci9030174*

Brawner, F. PhD. (2011) Framework for Philippine science teacher education. *Science education institute, department of science and technology (DOST)*. Philippines

Britner, S. L. (2008). Motivation in high school science students: a comparison of gender differences in life, physical, and earth science classes. *Journal of Research in Science Teaching, 45(8), 955-970.*

Britner, S. L., Zeldin, A. L., & Pajares, F. (2008). A comparative study of the self-efficacy beliefs of successful men and women in mathematics, science, and technology careers. *Journal of Research in Science Teaching, 45, 1036-1058.*

Britner, S.L., & Pajares, F. (2001). Self-efficacy beliefs, motivation, race, and gender in middle school science. *Journal of Women and Minorities in Science and Engineering, 7*, 271–285.

Brookhart, S.M, & Long B. A. (2011). Know your learning target. *Educational Leadership*, *68*(6), 66–69.

Brown, L. S., Holme T. P., James, F. & et.al., (2018) Chemistry for engineering students. Quezon City, C& E Publishing, Inc.

Bong, M. (2006). *Self-Efficacy Beliefs of Adolescents* (pp. 287–305). Greenwich, CT: Information Age Publishing.

BouJaoude, S., & Attieh, M. (2008). The effect of using concept maps as study tools on achievement in chemistry. *Eurasia Journal of Mathematics, Science & Technology Education, 4(3), 233-246*.

Burila, JM.P., Garia,EJ, L., & Lahay-lahay, J.S., (2014). *Chemistry anxiety, self-efficacy, and chemistry performance of grade 9 students.* (Unpublished research) West Visayas State University, College of Education, Iloilo City

Capa Aydin, Y., & Uzuntiryaki, E. (2009). Development and psychometric evaluation of the high school chemistry self-efficacy scale. *Educational and Psychological Measurement, 69(5), 868-880.*

Cavallo, A.M.L., Potter, W.H., & Rozman, M. (2004). Gender differences in learning constructs, shifts in learning constructs, and their relationship to course achievement in a structured inquiry, yearlong college physics course for life science majors. *School Science & Mathematics, 104(6), 288-300.*

Chamberlin, M. & Powers, R. (2010). The promise of differentiated instruction for enhancing the mathematical understanding of college students. *Teaching Mathematics and its applications, 29,113-139.*

Chang, R. (2007) Chemistry, tenth edition. New York, NY 10020. Mcgraw-Hill Companies Inc.

Cheung, D. (2011 Cheung, D. (2011). Evaluating student attitudes toward chemistry lessons to enhance teaching in the secondary school. *Educación Equímica*. Publicado en línea el 21 de enero de 2011.

Chi, M. T. H. & Roscoe, R. D. (2002). The processes and challenges of conceptual change. *Reconsidering conceptual change. issues in theory and practice.* Highom, MA, USA, Kluwer Academic Publishers.

Claesgens, J., Scalise, K., & Stacy, A. (2013). Mapping student understanding in chemistry: The perspective of chemists. Educación Equímica.

Cooper, C. I., & Cox, P. T. (2012). A Genetically Optimized Predictive System for Success in General Chemistry Using a Diagnostic Algebra Test. *Journal of Science Education and Technology, 21*(1), 197-205.

Croft M. & de Berg K., (2014). From common sense concepts to scientifically conditioned concepts of chemical bonding: a historical and textbook approach designed to address learning and teaching issues at the secondary school level. *Sci. Educ., 23(9), 1733–1761, DOI: 10.1007/s11191-014-9683-0.*

Cummins, J. (2000). *Language, power and pedagogy: Bilingual children in the crossfire*. Clevedon, England: Multilingual Matters

Dalgety, J. & Coll, R. K. (2006). Exploring first-year science students' chemistry self-efficacy. *International Journal of Science and Mathematics Education, 4, 97-116. doi: 10.1007/s10763-005-1080-3.*

Damavandi, M. & Kashani, Z. (2010). Effect of mastery learning method on performance and attitude of the weak students in chemistry. *Procedia Social and Behavioral Sciences 5 (2010) 1574–1579.*

De Berg, K. (2012). using the origin of chemical ideas to enhance an understanding of the chemistry of air: issues of challenges for including mathematics in the teaching and learning of chemistry *Educ. quím., publicado en línea el 11 de abril de 2012*

De Jong O. & Taber K. S., (2014). *Many faces of high school chemistry, in Lederman* New York, NY: Routledge, vol. II.

Demircioglu, G., Ayas, A., and Demircioglu H. (2005). Conceptual change achieved through a new teaching program on acids and bases. *Educational Research. KTU Fatih Education Faculty, Department of Secondary Science Education*

De Vos, W., Bulte, A. M. W., & Pilot, A. (2002). Chemistry curricula for general education: analysis and elements of a design. *Chemical education: towards research-based practice* (pp. 101-124). Dordrecht: Kluwer Academic Press.

Department of Education (2013). *Chemistry Curriculum and Assessment guide (Secondary 4–6).*

Department of Education (2010). *Education Statistics in South Africa*. Pretoria: Government Printer.

De Ramos-Samala, H. (2017) Spiral progression approach in teaching science: a case study. *Knowledge E. DOI:10.18502/kss.v3i6.2404*

Drechsler, M. (2007). *Models in chemistry education -a study of teaching and learning acids and bases in Swedish upper secondary schools.* (Unpublished Dissertation). Karlstad University Studies. Karlstad Sweden

Evans, B.T. (2011). Dual-process theories of reasoning: *Contemporary issues and developmental applications. Developmental Review, 31(2), 86-102.*

Eilks, I. (2015). Experiences and reflections about teaching atomic structure in a jigsaw classroom in lower secondary school chemistry lessons. *Chemical Education Research. Journal of Chemical Education. Vol. 82 No 2*.

Fairbrother, R. (2000). Strategies for learning. In M. Monk & J. Osborne (Eds.). *good practice in science teaching. what research has to say* (pp. 7-24). Philadelphia, PA: Open University Press, 7-24.

Ferrell, B. (2016) Evaluation of students' interest, effort beliefs, and self-efficacy in general chemistry. *Scholarship & creative works @ digital UNC*. University of Northern Colorado

Ferrell, B., Phillips, M.M., & Barbera, J. (2016). Connecting achievement motivation to performance in general chemistry. *Chemistry Education Research and Practice, 17(4), 1054-1066.*

Finn, K. V. & Frone, M. R. (2004). Academic cheating: The role of students' self-efficacy and identification with school. *Association for Supervision and Curriculum Development. Nov. 9, 2004, vol.2 No 23.*

Finnie, R. & Meng, R. (2006). *The importance of functional literacy: reading and math skills and labour market outcomes of high school drop outs*. Unpublished Thesis.

University of Philippines

Fraser B. J. & Chionh, Y. H. (2009). Classroom environment, achievement, attitudes, and self-esteem in geography and mathematics in Singapore. *International Research in Geographical and Environment Education, 18(1), 29-44.doi:10.1080/10382040802591530.*

Fredua-Kwarteng, E. (2015). Learning mathematics in English at basic schools in Ghana: A benefit or hindrance? *European Journal of Educational Research, 4*(3), 124-139. doi:10.12973/eu-jer.4.3.124

Gaumer-Erickson, A.S & Noonan, P.M. (2018). Self-efficacy formative questionnaire. *In The skills that matter: Teaching interpersonal and intrapersonal competencies in any classroom (pp.175-176).* Corwin.

Gilbert, J. K. (2006). On the nature of context in chemical education. *International Journal of Science Education, 28(9), 957-976.*

Gillespie R. J. & Robinson E. A., (2007). Gilbert N. Lewis and the chemical bond: the electron pair and the octet rule from 1916 to the present day. *J. Compute. Chem., 28(1), 87–97, doi: 10.1002/jcc.20545.*

Gonthier J. F., Steinmann S. N., WodrichM. D. & Corminboeuf C., (2012). Quantification of ‘‘fuzzy’’ chemical concepts: a computational perspective. *Chem. Soc. Rev., 41(13), 4671–4687, DOI: 10.1039/C2CS35037H.*

Gonzales, A. L. (2018). Exploring technological, pedagogical, and content knowledge (TPACK) and self-efficacy belief of senior high school biology teachers in Batangas City. The *Palawan Scientist*, 10, 29–47.

Green, S.K. (2002). Using an expectancy-value approach to examine teachers' motivational strategies. *Teaching and Teacher Education. 18, 989-1005.*

Grosch, R., & Rodrigo, T. (2013). The causes of poor performance in English language among senior secondary school students in Dutse Metropolis of Jigawa State, Nigeria. *Journal of Research & Method in Education,4*(5) 41-47.

Grove N. P., Cooper M. M., & Cox E. L., (2012). Does mechanistic thinking improve student success in organic chemistry? *Journal of Chemical Education, 89, 850–853.*

Hamaideh, H. S., & Hamdan-Monsour. M. A., (2014) Psychological, cognitive, and personal variables that predict college academic achievement among health sciences students. *ResearchGate. 34 (5) doi:10.1016/j.nedt.2013.09.010*

Hammar, M. (2013) Teaching the gas properties and gas laws: an inquiry unit with alternative assessment. Dissertations, Master's Theses and Master's Reports. Michigan Technological University

Hanson, R. (2016). Ghanaian teacher trainees' conceptual understanding of stoichiometry. *Journal of Education and e-learning Research*

Helmestine, A, M. PhD., (2019) The 5 main branches of chemistry. Retrieved form

Chemistry2011.org(2019)

Hofstein, A., & Kesner, M. (2006). Industrial chemistry and school chemistry: making chemistry studies more relevant, *International Journal of Science Education, 28(9), 1017-1039.*

Hofstein-Lunnetta A. (2004). The inquiry laboratory as a source for development of metacognitive skills, *International. Journal of Science and Mathematics Education*, *6*, 601-627.

Holbrook, J., & Rannikmäe, M., (2007). The nature of science education for enhancing scientific literacy, *International Journal of Science Education, 29(11), 1347-1362.*

Holbrook, J. (2005). Making chemistry teaching relevant: *Chemical Educational International, Vol.1*

Honicke, T., & Broadbent, J. (2016). The influence of academic self-efficacy on academic performance: a systematic review. *Educational Research Review, 17(1), 63-84.*

Hottecke, D., (2000). How and what can we learn from replicating historical experiments? a case study, *Science & Education, 9(4), 343-362*

Huling, C. (2014). *Singing to a star: The school meaning of second generation of Salvadorean students (Doctoral dissertation).* George Mason University: Fairfax.

Jiang, X, (2011). The role of first language literacy and second language proficiency in second language reading comprehension. *The Reading Matrix 11(2), 177 – 190.* Retrieved from http://www.readingmatrix.com/articles/april_2011/jiang.pdf

Jauco, M. C., Jerusalem, V. L., Agudong, J. A., & et.al., (2016) General chemistry 1. Manila, Mindshapers Co., Inc.

Jones, M. G., & Leagon, M. (2014). Science teacher attitudes and beliefs. In N. G. Lederman & S. K. Abell (Eds.), *Handbook of Research on Science Education Volume II* (pp.830-847). New York, NY: Routledge.

Judge, T., Jackson, C., Shaw, J., Scott, B., & Rich, B. (2007). Self-efficacy and work-related performance: the integral role of individual differences. *Journal of applied psychology, 92, 107-127.*

Kaya, E., & Geban, O. (2011). The effect of conceptual change-based instruction on students' attitudes toward chemistry. *Procedia Social and Behavioral Sciences 15 (2011) 515-519.*

Kaskaya, A (2012). Evaluation of the research in the scope of the proficiency of teachers in terms of subject, aim. method, and results. *Educational Sciences: Theory and Practice 12121*.Spring.800-805.

Kipnis, M., & Hofstein A., (2008). The inquiry laboratory as a source for development of metacognitive skills. *International journal pf science and mathematics education 6(3), 601-627.doi 10.1007/s10763-007-9066-y.*

Klobas, J., Renzi, S., & Nigreli M.L., (2007). A scale for the measurement of self-efficacy for learning (SEL) at university. Carlo F. *Dondena Centre for Research on Social Dynamics*

Koballa, T. R., & Glynn, S. M. (2007). *Attitudinal and motivational constructs in science learning.* Mahwah, NJ: Lawrence Erlbaum Associates.

Koleva, M. & Skopalik-Nacheva, L. (2012*).* Making chemistry an attractive subject for lifelong learning: an interactive approach in presenting education content: *New Perspectives in Science Education.*

Koper, R. (2003) *Representing the learning design of units of learning*. Open University of the Netherlands Educational Technology Expertise Center (OTEC) Valkenburgerweg 167.

Koseoglu, Y., (2015). Self-Efficacy and academic achievement- A case from Turkey. *Journal of Education and Practice. Vol.6, no.29*

Kousathana, M. & Tsaparlis, G.T., (2002). Students' errors in solving numerical chemical equilibrium problems. Chemistry Education: *Research and Practice in Europe, 3(1): 5-17.*

Lalich, I. J., Taylor, M. J., & Pribyl, J. R. (2006). *Identification of the correlation between student self-efficacy and final course percentage in a general chemistry course.* Minnesota State University, Mankato.

Lane, J., & Lane, A.M. (2001). Self-efficacy and academic performance. *Social Behavior and Personality, 29,687-694.*

Laureano, R.A., Espinosa, A.A. & Avilla, R.A. (2015). Effects of grade 9 science learner's material on students' self-regulation and achievement in chemistry. *Electronic Journal of Science Education, 19*(8), 28-58.

Levy Nahum T., Mamlok-Naaman R., Hofstein A., & Taber K. S., (2010), Teaching and learning the concept of chemical bonding. *Stud. Sci. Educ., 46(2), 179–207, DOI: 10.1080/ 03057267.2010.504548.*

Lewis, S.E. (2007). Predicting at-risk students in general chemistry: comparing formal thought to a general achievement measure. *Chemistry Education Research and Practice, 8, 32–51.*

Lewis, S.E. & Lewis, J.E. (2007). Predicting at-risk students in general chemistry: comparing formal thought to a general achievement measure. *Chemistry Education Research and Practice, 8, 32–51.*

Licuanan, P. B., PhD., Ogena, E. B., Bautista, Ma. C., Rose B., & et.al., (2016). Teaching guide for senior high school general chemistry 1 specialized subject/ academic strand. Quezon City, Commission on Higher Education

Lima, K. E. C. & Vasconcelos, S. D., (2006). Analysis of science teaching methodology used by teachers from public schools in Recife, *Ensaio: Avaliação e Políticas*

Públicas em Educação, 14(52), 397-412.
Linnenbrink, E., & Pintrich, P. (2002). Motivation as an enabler for academic success. *School psychology review, 31*, 313-327.
Lodewyk, K. R. & Winne, P. H. (2005). Relations among the structure of learning tasks, achievement, and changes in Self-efficacy in secondary students. *Journal of Educational Psychology, 97, 3-12.*
Lozano, R., & Watson, M. K. (2013). Chemistry education for sustainability: assessing the chemistry curricula at Cardiff University. *Educación Equímica.*
Madronio, E. (2015). *Chemistry learning environment, attitudes and proficiency level of generation z learners*. Unpublished Thesis. Saint Mary's University, Bayombong, Nueva Vizcaya
Magdara, D. T. (2015). Chemistry teaching in selected public schools in Marawi city: an assessment. *International Journal of Social Science and Humanity, Vol. 5, No. 1, January 2015*
Mahyuddin, R., Elias, H., Loh S., Muhamad, F., Noordin, N., & Abdullah, M. (2006). The relationship between students' self–efficacy and their english language achievement. *Jurnal Pendidik dan Pendidikan, 21, 61 71.*
Mapa, A. P. PhD., Fidelino, T. B., & Rabago, L. M., PhD., (2001). Chemistry textbook in science and technology. Quezon City, SD Publications, Inc.
Mataka, L.M. & Kowalske, M.G. (2015). The influence of PBL on students' self-efficacy beliefs in chemistry. *Chemistry Education Research and Practice, 16(4), 929-938*
McNeill K.L., & Pimentel D.S., (2010). Scientific disclosure in three urban classrooms: the role of the teacher in engaging high school students in argumentation. *Science Education, 94 (2), 203-229, doi: 10.1002/sce.20364*
Meece, J., Anderman, E., & Anderman, L. (2006). Classroom goal structure, student motivation, and academic achievement. *Annual Review of Psychology, 57*, *487-503.*
Merchant, Z., Goetz T., Keeney-Kennicutt, W., Kwok, O., & et al. (2012). The learner characteristics, features of desktop 3D virtual reality environments, and college chemistry instruction: a structural equation modeling analysis. *Computers & Education.*
Miller, P. (2016). *Learning styles: The multimedia of the mind research report.* Retrieved from *http://en.wikipedia.org/wiki/Learning_styles*
Mills, J., & Blankstein, K. (2000). Perfectionism, intrinsic vs extrinsic motivation and motivated strategies for learning. a multidimensional analysis of university students. *Personality and individual differences, 29, 1191-1204.*
Moss, C. M., & Brookhart, S. M. (2009). *Advancing formative assessment in every classroom: A guide for instructional leaders*. Alexandria, VA: Association for Supervision and Curriculum Development.

Nalipay, M. J.N, & Alfonso, M.K.S. (2018) Career and talent development self-efficacy of filipino students: the role of self-compassion and hoe. *Philippine Journal of Psychology*, 51(1),101-120

Ng, S. H, Solis, N. M, Eusebio, J.P, Aguilar, M.D & Yu, S.H (2008*). Factors associated with the English proficiency of elementary pupils at central Philippine university.* Unpublished Thesis. Central Philippine University, College of Education, Jaro, Iloilo City

Navarro, R., & De Guzman-Santos, R. (2013). Assessment of learning 2 authentic assessment of students learning outcomes. Cubao, Q.C., Metro Manila.

Naaman-Manlok, R., & Holstein, A. (2011). High school students' attitude toward and interest in learning chemistry. *Educación Equímica.*

Nasiriyan, A., Azar, H., K. Noruzy, A. & Dalvand, M. R. (2011). A model of self-efficacy, task value, achievement goals, effort, and mathematics achievement. *International Journal of Academic Research. 3 (2). 612-618.*

Nieswandt, M., (2007). Student and conceptual understanding in learning chemistry. *Journal of Research in Science Teaching 44 (7), 908-937. Doi;10.1002/tea.20169*

Noveanu, G. (2011). Curricular provision and students' attainment in chemistry: the gap of meaning. *Procedia Social and Behavioral Sciences 11 (2011) 210–214*

Nurisa, I., & Arty, I. (2018). Measuring students' chemistry literacy ability of acid and base concepts. *Journal of Physics: Conference Series*

Oke, O. K., & Alam, G. M. (2010). Comparative evaluation of the effectiveness of 2 and 3D visualizations in students' understanding of structures of organic molecules. *International Journal of the Physical Sciences, 5(5), 605–611.*

Oluwatelure, T.A. & Olonruntegbe, K.O. (2010). Effects of parental involvement on student's attitude and performance. *Science academic journal of microbiology research, 4 (1), 1-9*

Orbe, J. R., Espinosa, A. A., & Datukan, J. T., (2018). Teaching chemistry in a spiral progression approach: lessons from science teachers in the Philippines. *Australian Journal of Teacher Education, 43(4).*

Osborne, J., & Dillon, J. (2008). *Science education in Europe: critical reflections.* London: The Nuffield Foundation.

Osborne, J., Simon, S., & Collins, S. (2003). Attitude towards science: a review of the literature and its implications', *International Journal of Science Education*, *25, 1049-1079*

Ozowuba, G.U. (2018) *Relationship between English proficiency and academic achievement of Nigerian secondary school students.* Walden dissertation and doctoral studies. Walden University

O'Dwyer, L. (2009). New measures of English language proficiency and their relationship to performance on large-scale content assessments. *Issues & Answers Report, 066*, 1-60.

Pajares, F. & Schunk, D. H. (2001). Self-beliefs and school success: self-efficacy, self-concept, and school achievement. London: Ablex Publishing.

Parker, C. E., Louie, J., & O'Dwyer, L. (2009). New measures of English language proficiency and their relationship to performance on large-scale content assessments. *Issues & Answers Report, 066*, 1-60. *Retrieved from* http://ies.ed.gov/ncee/edlabs

Pellegrino, J. W. (2013). *Proficiency in science: Assessment challenges and opportunities*. American Association for the Advancement of Science.

Pilot, A., & Bulte, W. W., (2006). "Contexts" as a challenge for the chemistry curriculum: its successes and the needs for further development and understanding, *International Journal of Science Education, 28, 1087-1112.*

Pintrich, P.R. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich & M. Zeidner (Eds.), Handbook of Self-Regulation: *Theory, Research, and Applications. 452-502. San Diego, CA: Academic.*

Racca, R.M & Lasaten, R. C. (2018) English language proficiency and academic performance of Philippine science high schools' students. *International Journal of Languages, Literature and Linguistics, Vol. 2, No. 2,*

Ravikumar M. (2013). "Pre-service elementary teachers' self-efficacy beliefs about science using critical incident technique: a case study approach". electronic theses and dissertations. *2680pp. stars.library.ucf.edu*.

Saldivar, C. A. (2015) *Functional literacy in chemistry of grade 9 students and science teachers under the K-12 basic curriculum program.* Unpublished Thesis. Saint Mary's University, Bayombong, Nueva Vizcaya

Sanchez, JM. P., (2019). Indicators of asian achievement in chemistry: implications to the Philippine setting. *KIMIKA Volume 30, Number 1, pp. 18-30 (2019) © 2019 Kapisanang Kimika ng Pilipinas*

Saribas, D., & Bayram, H. (2009). Is it possible to improve science process skills and attitudes towards chemistry through the development of metacognitive skills embedded within a motivated chemistry lab?: a self-regulated learning approach. *Procedia Social and Behavioral Sciences 1 (2009) 61–72*

Savec, V. F. et al. (2006). In-service and pre-service teachers` opinion on the use of models in teaching chemistry. *Pedagogical Paper*, *53*, 381–390.

Sesen, B.A & Tarhan L. (2010). Promoting active learning in high school chemistry: learning achievement and attitude. *Procedia- Social and Behavioral Sciences, 2 (2), 2625-2630.doi.10.1016/j.sbspro.2010.03.384*

Schunk, D. H., & Pajares, F. (2002). The development of academic self-efficacy. In A. Wigfield & J. S. Eccles (Eds.), *Development of achievement motivation*, (pp. 15-

31). San Diego, CA: Academic Press.

Schuttlefield, J. D., Kirk, J., Pienta, N. J., & Tang, H. (2012). Investigating the effect of complexity factors on gas law problems. *Journal of Chemical Education, 89, 586-591.*

Sichau, C. (2000). Practicing helps: thermodynamics, history, and experiment, *Science & Education, 9(4), 389-398*

Soti, F. & Mutch, C. (2011). Teaching and learning food and textiles in Samoa: curriculum implementation as a contested process. Warkworth, NZ: *Pacific Circle Consortium for Education,* Vol. 23, pp.89-100.

Strack, R., Marques, M., & Del Pino, J. C., (2009). For another path in the construction of knowledge in chemistry education, *Química Nova na Escola, 31(1), 18-22.*

Stieff, M. (2011a). Improving representational competence using molecular simulations embedded in inquiry activities. *Journal of Research in Science Teaching, 48*(10*), 1137-1158.*

Stieff, M. (2011b). When is a molecule three-dimensional? a task-specific role for imagistic reasoning in advanced chemistry. *Science Education, 95(2), 310-336.*

Suaalii, F. (2013). *Supports and barriers to achievement in secondary school chemistry; exploring the teaching-learning of year 12 chemistry in Samoa.* (Unpublished doctoral dissertation) Massey University, Manawatu, New Zealand

Suraya, A. MD & Ali, Z. (2009). Metacognition and motivation in mathematical problem-solving. *The International Journal of Learning, 15, 121-132.*

Taber, K. S. (2002). *Chemical misconceptions - prevention, diagnosis, and cure*. London: Royal Society of Chemistry.

Taber K. S., (2001a). Shifting sands: a case study of conceptual development as competition between alternative conceptions, *Int. J. Sci. Educ., 23(7), 731–753, doi: 10.1080/ 09500690010006572.*

Taber K. S. & Coll R. K., (2002). Bonding. chemical education: towards research-based practice. *Kluwer Academic Publishers, pp. 213–234.*

Taylor, N., & Corrigan G., (2005). Empowerment and confidence: pre-service teachers learning to teach science through a program of self-regulated learning. *Canadian Journal of Science. 5(1), 41-61.*

Tayaban, J. (2015) *Students' assessment of RBEC and K-12 curriculum and their achievement in chemistry.* Unpublished Thesis. Saint Mary's University, Bayombong, Nueva Vizcaya

Tobin, K. & Llena, R. (2010). *Producing and maintaining culturally adaptive teaching and learning of science in urban schools.* Dordrecht, Netherlands: springer

U¨nal S., Calık M., Ayas A. & Coll R. K., (2006). A review of chemical bonding studies: needs, aims, methods of exploring students' conceptions, general knowledge claims and students' alternative conceptions. *Res. Sci. Technol. Educ., 24(2),* *141–172, DOI: 10.1080/02635140600811536.*

University of Cambridge, (2011b). *International A-Level Chemistry Syllabus*, Cambridge

Usher, L. & Pajares, F. (2008). Self-efficacy for self-regulated learning: a validation study*. Educational and Psychological Measurement, 68(3), 443-463*

Usher, L. & Pajares, F. (2006). Inviting confidence in school: invitations as a critical source of the academic self-efficacy beliefs of entering middle school students. *Journal of Invitational Theory and Practice, 12, 7-16.*

Uzuntiryaki, E. (2008). Exploring the sources of Turkish pre-service chemistry teachers' chemistry self-efficacy beliefs. *Australian Journal of Teacher Education, 33(6), 12-28.*

Uzuntiryaki, E. (2008). Exploring the sources of Turkish pre-service chemistry teachers' chemistry self-efficacy beliefs. *Australian Journal of Teacher Education, Volume 33/Issue 6, Article 2*

Uzuntiryaki, E. & Boz, Y. (2007). Turkish pre-service teachers' beliefs about the importance of teaching chemistry. *Australian Journal of Education, 32, 4.*

Uzuntiryaki, E. & Çapa Aydın, Y. (2007). The relationship between high school students' chemistry self-efficacy and chemistry achievement. *Proceedings 2nd European Variety in Chemistry Education, Prague*, 81-83, Charles University, Prague.

Uzuntiryaki-Kondakci, E. & Senay, A. (2015). Predicting chemistry achievement through task value, goal orientations, and self-efficacy: a structural model. *Croatian Journal of Education, 17*(3), 725-753.

Villafañe, S.M., Xu, X., & Raker, J.R., (2016). Self-efficacy and academic performance in first-semester organic chemistry: testing a model of reciprocal causation. *Chemistry Education Research and Practice, **17**, 973-984*

Whitten, K. W., Davis, R. E., Peck, L. M., Stanley, G. G. (2014). Chemistry, tenth edition. USA, Brooks/Cole, Cengage Learning

Yazon, A. D. (2015*) Self-esteem, self-efficacy and academic performance of the college of teacher education students at the Laguna state polytechnic university*. Unpublished Thesis. Los Banos campus, ay 2013-2014. Laguna State Polytechnic University, Los Banos, Laguna

Yusuf, M. (2011). Investigating the relationship between self- efficacy, achievement motivation, and self-regulated learning strategies of undergraduate students: a study of integrated motivational models. *Procedia Social and Behavioral Sciences 15 (2011) 2614-2617*

Zeldin, A. L., & Pajares, F. (2000). Against the odds: self-efficacy beliefs of women in mathematical, scientific, and technological careers. *American Educational Research Journal, 37, 215-246.*

Zimmerman, B. J. (2000). Attaining self-regulation: a social perspective. *Handbook of* *self-regulation* (pp. 13-39). San Diego: Academic Press.

Zusho, A., Pintrich, P. R., & Coppola, B. (2003). Skill and will: the role of motivation and cognition in the learning of college chemistry. *International Journal of Science Education, 25*, 1081-1094.