PERFORMANCE OF SENIOR HIGH SCHOOL STUDENTS IN SPIRAL PROGRESSION APPROACH OF THE K TO 12 SCIENCE CURRICULUM

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Master of Arts in Teaching (MAT)
Major in Physics

MYRNIEL B. GAL
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APPROVAL SHEET

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To the faculty, staff and students of **Ramon T. Diaz National High School**, thank you for your cooperation.

Myrniel

DEDICATION

I am dedicating this humble piece of achievement to:

***Nilo S. Gal**, my father*

***Marilyn B. Gal**, my mother*

To my siblings,

Marvin**, **Mikko**, **Ma. Anrica**, **Missy** and **Michelle

To my grandparents,

Lolo Escoy & Lola Cit

And to my significant other,

John Rey D. Macha

*Lastly, I am dedicating this humble piece of achievement to **God Almighty**, my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding. He has been the source of my strength throughout this journey and on His wings only I have soared.*

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ABSTRACT

This study aimed to determine the level of performance under spiral progression approach in the K to 12 Science Curriculum to the Grade 12 senior high school students of Ramon T. Diaz National High School, school year 2017-2018. This study utilized a qualitative and quantitative descriptive research, to know the level of performance of senior high school students in terms of developing scientific understanding and acquiring science process skills and their experiences under variates of student-respondents. In the level of science process skills, the student-respondents has "very high" level on observation skills as evidenced by the grand mean of 3.54 with standard deviation of 0.49. This indicates that under spiral progression approach the student-respondents' are observant in identifying changes in science-related topics. Overall, the student-respondents have high level scientific understanding based on the scores from the multiple choice test, indicating that student has better understanding on the content of the new design curriculum in science. As a whole, student-respondents' rated "high" on the level of science process skills acquired by the respondents, that only means that varied activities in the science curriculum of the K to 12 program are effective. Teachers' must be sent to training, seminars, workshops and all about the new approach being used in the science curriculum for them to be equipped with the necessary knowledge in teaching their students.

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Chapter 1

THE PROBLEM AND ITS SETTING

Introduction

The Philippine K to 12 curricular programs provides twelve years of basic education similar with most of the countries in the world. The addition of two years on the former ten-year basic education program was envisioned for mastery of learning making learners better prepared for the world of work and preparing them for collegiate education. The features of the K to 12 Enhanced Basic Education Program include the strengthened Science and Mathematics Education which follows a spiral progression approach (Quijano, 2012).

Prior to the implementation of K to 12 Curriculum, science subject was taught by discipline and by grade level where Grade 7 focused on Earth Science, Grade 8 in Biology, Grade 9 in Chemistry and Grade 10 in Physics where students has the mastery of topics for each sciences. In the new science curriculum, things are not anymore the same because it utilizes now the spiral progression approach in instruction which is articulated in Republic Act No. 105333 (Piamonte, 2012).

To realize learning goals, effective learning needs to occur and educational theories, tested empirically in the 20th century and evidenced in the literature, show that effective adult learning takes place when there is a cycle of experience, reflection, thinking and planning, where there is deep learning for understanding, rather than surface learning for assessment and what learners already know is assimilated into new learning. From these pedagogical perspectives, the spiral curriculum evolved, with horizontal and vertical integration of topics (Coelho, 2015).

SEAMEO - INNOTECH' K to 12 Toolkit blurted out that the new curriculum ensures' smooth transition between grade levels and continuum of competencies through spiral progression approach where learning of knowledge, skills, values and attitudes increase in depth and breadth', ensuring integrated and seamless learning (SEAMEO – INNOTECH, 2010).

Corpuz (2003) defined Spiral Progression as the process where basic principles are introduced in the first grade and are rediscovered in succeeding grades in more complicated forms. Concepts are introduced at early age and re-taught in succeeding years in an increasingly sophisticated fashion.

Angeles (2013) added that the new curriculum is composed of set of activities like, collaborative learning, peer tutoring, outcome-based performance or performance task. In which the students are expose to socializing, sharing thoughts and ideas or brainstorming, communicating, expressing their multiple intelligences, abilities and skills. In this same manner, the idea in spiral progression approach is to expose the learners into a wide variety of concepts or topics and disciplines, until they mastered it by studying it over and over again but with different deepening of complexity.

On the other hand, Snider (2004) cited the advantages and disadvantages of a spiral progression approach, according to him, spiral progression approach avoids disjunctions between stages of schooling, it allows learners to learn topics and skills appropriate to their developmental or cognitive stages, and it strengthens retention and mastery of topics and skills as they are revisited and consolidated. But, the problem with the spiral design is that the rate for introducing new concepts is often either too fast or too slow. All concepts are allotted the same amount of time whether they are easy or difficult to master. Units are approximately the same length, and each topic within a unit is one day's lesson. The fact that an entire class period must be devoted to a single concept makes it difficult to sequence instruction to ensure that students acquire necessary pre-skills before introducing a difficult skill.

In addition, in the study conducted by Resurrection and Adanza (2015) on "Spiral Progression Approach in Teaching Science in Public and Private Schools", their study found out that teachers should be given more time, seminars and trainings because of the difficulty they encountered in teaching science and teachers need to change or improve their way of teaching and learning to adapt spiral progression approach.

However, teachers are doing their best to adapt the new science curriculum by using new technologies, reading more books and resources, attending seminars and by collaborating with their fellow teachers and they added that somehow the spiral progression approach in the new science curriculum can create a globally competitive and dynamic learners and citizens (Adanza, et al., 2015).

Furthermore, Adams & Sargent, 2012 highlighted the outcome performance of the students under spiral progression approach in China. Chinese government made a move to change their curriculum form subject-centered to student-centered scheme. Their study showed that the curriculum brought changes in the educational aspect of China, reducing the student stress level but increased in student participation. With the results gathered, it is concluded that the new curriculum entails a better way of learning to the students from the time they shifted their curriculum.

The Philippines with the Department of Educations' K to 12 Program goes with the spiral progression approach where in a major part of the implementation is the transition stage, which is crucial for the success of the reform. It is therefore necessary to pay close attention to the transition process as this stage can easily lead to failure if not implemented correctly.

Ramon T. Diaz National High School in Gandara, Samar is one of the big schools in the Samar Division composing of approximately 2,200 enrollees coming from different barangays of the said municipality. With the large number of enrollees, Ramon T. Diaz National High School will serve as a representative school for the whole Division of Samar as sample of this study. The researcher herself was a former teacher of the school handling junior and senior high school students and is familiar on how the school functions, thus the researcher chose to conduct the study in Ramon T. Diaz National High School.

The implementation of the new science curriculum brought changes to the part of the school administrators, teachers and especially to the students. On how spiral approach applied in science create confusion to the students particularly on the transition of topics every grade level, which is the main problem of the students of Ramon T. Diaz National High School.

The said case above is quite apprehensive and it was in this regard that the researcher was encouraged to conduct this research to determine the performance of senior high school students under spiral progression approach of the K to 12 science curriculum.

Statement of the Problem

This study aimed to determine the level of performance under spiral progression approach in the K to 12 Science Curriculum to the Grade 12 senior high school students of Ramon T. Diaz National High School, school year 2017-2018.

Specifically, this study sought to answer the following questions:

1. What is the profile of the student-respondents in terms of the following profile variates?

   1.1 age and sex;

   1.2 track or specialization;

1.3 mid-term grades of second semester, and

1.4 average family monthly income?

2. What is the level of performance of the Grade 12 senior high school students under the spiral progression approach in the K to 12 Science Curriculum to the student-respondents in terms of developing:

2.1 scientific understanding, and

2.2 science process skills?

3. What are the experiences of the senior high school students in the K to 12 Science Curriculum?

4. Is there a significant relationship between student-respondents' profile and level of performance under spiral progression approach in the K to 12 Science Curriculum in terms of developing:

4.1 scientific understanding, and

4.2 science process skills?

5. Is there a significant difference between male and female respondents in terms of:

5.1 scientific understanding, and

5.2 science process skills?

Hypotheses

The following hypotheses were tested in this study:

1. There is no significant relationship between the student-respondents' profile and level of scientific understanding under spiral progression approach in the K to 12 Science Curriculum.

2. There is no significant relationship between the student-respondents' profile and level of science process skills under spiral progression approach in the K to 12 Science Curriculum.

3. There is no significant difference as to the male and female respondents in terms of:

3.1 scientific understanding, and

3.2 science process skills.

Theoretical Framework

The Spiral Curriculum is predicated on Cognitive Theory advanced by Jerome Bruner. Learning is an active process in which learners construct new ideas or concepts based upon their current or past knowledge. The learner selects and transforms information, constructs hypothesis, and make decisions relying on a cognitive structure (Bruner, 1966).

Brewer and Daane (2002) noted that constructivism treats knowledge as concepts that students can construct through their own experiences. In this regards, Bruner's (1991) constructivist theory is grounded on a spiral model for instruction. Bruner's spiral model is used to keep cycling the information through motivation, engagement and discovery. Cognitive theory involves investigating, inquiring and constructing knowledge, therefore instruction should aim at stimulating students to search for, manipulate and explore new knowledge to solve problems. In spiral techniques, learning is not sequential, but curved when learners move upward, downward and inward to understand and formulate knowledge. Hence, spiral technique is more effective pedagogically than traditional teaching methods because the spiral model is integrative, allowing linking theory into practice (Olson, 2014).

In addition, from constructivists' point of view, learners construct new ideas based upon their previously learned knowledge. Gradual mastery of the desired competencies is achieved through revisiting core ideas in several process and relating new knowledge or skills with the previous. Therefore, unlike the old curriculum where so much knowledge was expected to be learnt within a limited period, the K to 12 curriculum on the other hand is seamless. It has its focus on understanding for mastery and it ensures smooth transition between grade levels and continuum of competencies through spiral progression.

Bruner proposed a spiral curriculum concept to facilitate the structuring of a curriculum. It must be noted that the spiral progression approach was adapted in the country emphasizing the need to advance in the context of scientific and technological literacy.

The K-12 education program, serves a response to the urgent need to improve the quality of Philippine basic education. The aim of this reform is to enhance the curriculum so as to facilitate the mastery of basic competencies. This concludes that the spiral approach by John Bruner can contribute to the achievement of this aim. Integrated and seamless learning, as one of the salient features of the K to 12 Education Program, is indeed not impossible because the new curriculum in science follow a spiral progression where learning of skills, knowledge and attitudes increase in both breadth and depth.

Conceptual Framework

Figure 1 illustrates the conceptual framework of the study. In the context of the study, the identified independent variable were the level of scientific understanding, level of science process skills of the student-respondent's in spiral progression approach. These constitute the profile variates of the respondents like age, sex, track or specialization, mid-term grades in physical science and average family monthly income. The student-respondents' were the pioneering graduates who have undergone spiral progression approach of the K to 12 science curriculum, therefore, they serve as unit of analysis in the study to determine the level of performance of grade 12 senior high school students in science. This is the independent variable – the outcome affected by the existing condition. The variables in the study were taken into account by the researcher by analyzing them correlatively. In this manner, the researcher determined the level of scientific understanding, science process skills and experiences among senior high school students to evaluate their level of performance in physical science under spiral progression approach.

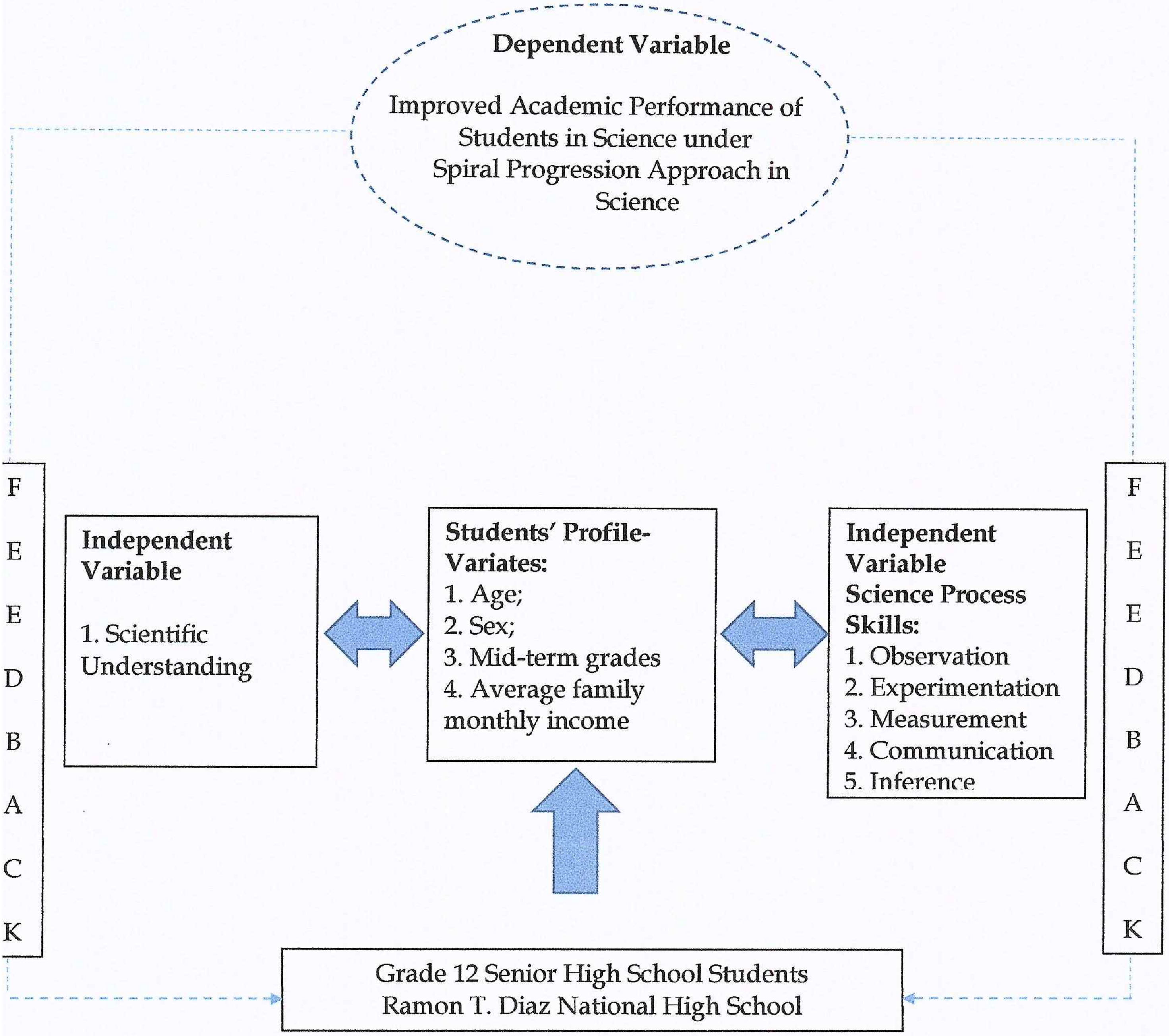

Figure 1. Conceptual Framework of the Study

Furthermore, the interpretation of the results of the study would give the school administration of Ramon T. Diaz National High School in its efforts towards the improvement of quality education and to provide appropriate intervention to the students.

Significance of the Study

The researcher believes that the result of this study would be beneficial to the students, teachers, parents, school administrators and future researchers.

School administrators. They are the one who would be gaining insights as to what measures are appropriate to help the teachers orient both students and teachers regarding the spiral progression approach in the K to 12 science curriculum. This study would also be of benefit to the school administrator considering that they are the policy makers, the product of the institution would transcend to the type of or kind of education their institution is offering. Hence, producing quality learners will reflect to the commendable manner of nurturing their learners.

Teachers. The result of this study would make the science teachers master the new science curriculum applying spiral progression approach and employ teaching strategies that would inspire and prepare minds-on and hands-on activities to make science interesting and engaging to the students fully embraced the new curriculum. In this study, they are the instruments in the materialization of the government educational programs.

Students. The results and findings would be of benefits to them since they are expected to develop the 21st century skills required in the K to 12 science curriculum through spiral progression approach.

Future researchers. The findings of this study would serve as additional information for those interested in investigating deeply into other factors as to the performance of the students under spiral progression approach in the K to 12 science curriculum.

Scope and Delimitation

This study dealt on the level of performance of senior high school students in the subject physical science under spiral progression approach.

Since, Ramon T. Diaz National High School is one of the big schools in the Division of Samar, the school will serve as a representative school to determine the performance of the students in the spiral progression approach.

The participants of the study were the grade 12 senior high school students who were the first batch of the K to 12 Curriculum and who were officially enrolled in the Learner's Information System (LIS) of Ramon T. Diaz National High School. There were only selected participants for each of the track offered by the school.

A major limitation of the study was the subject physical science; it's very broad and cannot be fully covered in one study. Therefore, this study was concentrated on the first quarter topics covered in their discussion, as follows:

1.)Light elements in Big Bang Theory, 2.) star formation and evolution, 3.) nuclear fusion reaction in stars, 4.) contributions of the alchemists to the science of chemistry, 5.) atom and its sub-atomic particles, 6.) Contributions of Thompson, Rutherford, Mosley, and Bohr to the understanding of the structure of atom, 7.) nuclear model of atom, 8.) contributions of John Dalton toward the understanding of the concept of the chemical elements, 9.) polar or non-polar; and 10.) types of intermolecular forces.

This study was conducted during the second semester school year 2017-2018.

Definition of Terms

The following terms are defined according to their used in this study.

Basic education. Conceptually, this refers to the whole range of educational activities taking place in various settings – formal and non – formal, that aims to meet basic learning needs and also comprises primary education and lower secondary education.

K to 12. Letter "K" refers to kindergarten and "12" refers to the additional two years in the basic education. It is the additional years after fourth year in secondary school.

Performance. This refers to the academic achievement of the students as evidenced by test results or marks given by the teacher based from the criteria such as: periodical test, written outputs and participation or recitation.

Operationally, this is used to determine the scientific understanding and science process skills of the students.

Science. Conceptually, this refers to the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology. In this study, new design science curriculum in the K to 12 program was assessed as to the performance of the senior high school students under spiral progression approach.

Spiral progression. This refers to the approach that introduces key concepts to students at a young age and covers these concepts repeatedly, with increasing degrees of complexity. Operationally, this is use to describe the context of the Republic Act 10533 of the Philippines, otherwise known as the Enhanced Basic Education Act of 2013.

Students. This refers to a person who formally engaged in learning, who studies, investigates or examines. As used in this study, they pertains to the grade 12 senior high school students of Ramon T. Diaz National High School and nationwide.

Chapter 2

REVIEW OF RELATED LITERATURE AND STUDIES

This section presents and discusses ideas and studies that are related to the focus of this research material. Different sources of information are reviewed to gain more insights on the content of this study.

Related Literature

The legal basis of Philippines on the implementation of the new curriculum in the educational system states that the graduate of basic education shall be an empowered individual who has learned, through a program that is rooted on sound educational life, the competence to engage in work and productive, the ability to co-exist in fruitful harmony with local and global communities, the capability to engage in autonomous, creative and critical thinking and the capacity and willingness to transform others and ones' self.

Commentators on the evolution of the school curriculum and its design acknowledge the influence of Jerome Bruner (1915). Bruner realized that construction of knowledge relies on a continual process through which learners develop complexity of thinking by integrating new experiences, observations and knowledge with what they already know and have experienced. According to Bruner, the child already processes some sort of mental templates for interpreting the world, new experiences are matched against these and eventually the templates develop and change to accommodate new ways of thinking about the world (Bruner, 1966).

In 1960, Bruner proposed a spiral curriculum concept to facilitate structuring a curriculum ´around the great issues, principles, and values that a society deems worthy of the continual concern of its members´ (Bruner, 1960). The next decades many school system educators attempted to implement this concept into their curriculum.

Spiral progression approach in curriculum is derived from Bruner's spiral curriculum model (Lucas, 2011). Curriculum as it develops revisits the basic idea repeatedly, building upon them until the student grasped the full formal apparatus that goes with them (Smith, 2002). Bruner stressed that teaching lead in boosting cognitive development. Curriculum is organized in a spiral manner so that the student continually builds upon what they have already learned.

Bruner suggested that cognitive process precede perception rather than the other way around, that a person may not perceive an object until he or she has recognized it. These cognitive theories of perception emphasize the role of knowledge in how we interpret the world.

It was in the 1980s, that a body of literature had accumulated in support of individual components of a spiral curriculum model. Reigeluth and Stein (1983) published the seminal work on "The Elaboration Theory of Instruction". It proposes that when structuring a course, it should be organized in a simple-to-complex, general-to-detailed, abstract-to-concrete manner. Another principle is that one should follow learning prerequisite sequence; it is applied to individual lessons within a course. In order for a student to develop from simple to more complex lessons, certain prerequisite knowledge and skills must first be mastered. This prerequisite sequencing provides linkages between each lesson as student spirals upwards in a course of a study. As new knowledge and skills are introduced in subsequent lessons, they reinforce what is already learnt and become related to previously learned information. What the student gradually achieves is a rich breadth and depth of information that is not normally developed in curricula where each topic is discrete and disconnected from each other (Dowding, 1993).

Hawitt (2006) enlightened that curriculum adaptation is using already developed, existing curriculum and materials and adapting them to fit a specific curriculum purpose. In addition, he made mention of four characteristics in any curriculum development or adaptations.

According to Martin (2008), spiral curriculum is a design framework which will help science teachers construct lessons, activities or projects that target the development of thinking skills and dispositions which do not stop at identification. It involves progression and continuity in learning science. Progression describes students' personal journeys through education and ways, in which they acquire, apply and develop their skills, knowledge and understanding in increasingly challenging situations. Continuity is concerned with ways in which the education system structures experience and provides sufficient challenge and progress for learners in a recognizable curricular landscape. Therefore, spiral progression approaches an approach or a way on how to implement the spiral curriculum.

After the mastery of the initial topic, the student spirals upwards as the new knowledge is introduced in the next lesson, enabling students to reinforce what is already learned. In the end, a rich breadth and depth of knowledge is achieved. With this procedure, the previously learned concept is reviewed hence improving its retention. And also the topic may be progressively elaborated when it is reintroduced leading to a broadened understanding and transfer (Mantiza, 2013).

In addition, the spiral progression approach is a child-centered approach. According to Angeles (2013), the new curriculum is composed of set of activities like, collaborative learning, peer tutoring, outcome-based performance or performance task. In which the students are expose to socializing, sharing thoughts and ideas or brainstorming, communicating, expressing their multiple intelligences, abilities and skills.

On another point of view, in an article entitled, "Are Schools Preparing Students to Meet Employers' Need" which was relayed by Brown (2006), he strikingly uttered that there is something wrong with the curriculum whereby educators, parents, employers all seen to agree on the types of skills they believe students should be developing. Nevertheless, the same finds that the Traditional Curriculum, divided up into separate subjects, neither engages students nor prepares them for productive lives. He believes that the answer to both problems is to have students design their own curricula.

Moreover, one of the most recent studies of Gnanamalar and Daniel (2015), they noted that the K to 12 Science Curriculum framework is meant for learners to gain skills in obtaining scientific and technological information from varied sources about global issues that have impact on the country, acquire attitudes that will allow them to innovate and or create products that is useful to the community or country and process information to get relevant data for a problem at hand, to make plans related to their interests and expertise, considering the needs of their community and the country as provided by the Department of Education and SEAMEO INNOTECH. If this so, then there is a great need to deliberate the Science teachers' background, so might be explained and delivered with the aid of the personnel.

In addition, the U.S National Science Board's Science and Engineering Indicators (2002) highlighted that analysis conducted in conjunction with TIMSS documented that curriculum guides in the United States include more topics than is the international norm. Most other countries focus on a limited number of topics, and each topic is generally completed before a new one is introduced. In contrast, U.S curriculums follow a spiral approach where topics are introduced in an elemental form in the early grades, then elaborated and extended in subsequent grades. One result of this is that U.S Curriculums are quite repetitive, because the same topic appears and reappears at several different grades (Schmidt, et al., 1997)

Another significant difference between the science curriculum in the Department of Education's K to 12 and the top performing countries is the Philippines curriculum is two years behind. The integrated science approach adopted by the United States and other countries stops at the end of the middle school while the Philippines expects to achieve at the end of grade 10. Teaching Science in an integrated approach requires specific training. Drawing a curriculum that recognizes the hierarchal nature of topic within a discipline not only provides the conditions helpful to learning, but also facilitates the required teaching abilities.

At present, with the new curriculum design in science, the content and science processes in the K to 12 Curriculum are intertwined and are being organized which make students curios and interested in different topics and activities. As a whole, the K to 12 science curriculum is a learner-centered and inquiry-based, emphasizing the use of evidence in constructing explanations. Concepts and skills in Life Sciences, Chemistry, Physics and Earth Sciences are presented with increasing levels of complexity from one grade level to another in spiral progression, thus paving the way to deeper understanding of concepts. These concepts and skills are integrated rather than disciplined-based, stressing the connections across science topics and other disciplines as well as application of concepts and thinking skills to real life. After completion of Grade 10, the students' learning competencies and skills will be assessed to match the areas of specialization or tracks they are to pursue in the senior high school level (K-12 Primer, 2012).

Employing Bruner's and Martin's comprehensive view on spiral progression approach, one can conclude that learners can really have a good performance in science applying the said approach. Through this, learners will gain scientific understanding and process skills that is relevant in making plans related to their interests and expertise.

It is therefore in the purpose of finding out the performance of senior high school students in the spiral progression approach of the K to 12 science curriculum that this research has been pursued.

Related Studies

The following studies are reviewed since they are deemed having significant bearing to the present study.

Educational reforms have to affect and improve multiple dimensions of science education practices. The curricula emerge as the main source that shapes these dimensions according to the new principles (Cobern, 2014).

In some of the studies shows that, in spite of the innovative curriculum reform efforts, teachers generally retain their traditional view of science (Jenkins, 2002). Aikenhead (2006) explained the reason for this resistance to the challenges caused by salient influences' on teacher's values, assumptions, beliefs, ideologies, self-identities, self-images, and loyalties to traditional school science. There are many reported problems that accompany the implementation of curriculum reform such as the difficulty in lesson preparation, insufficient subject matter knowledge (Guo, 2007), inadequacy of teachers in new pedagogies, poor quality of textbooks, considerable difficulty in changing roles of teachers and students, teachers' not taking enough support and training (Gray, 1999), and not being patient to see the permanent effects of new pedagogies on students.

The studies above bears similarities with the present study since it is the curriculum in Turkey is just being implemented facing difficulty as to what will be the outcome of the curriculum to the students and teachers as well.

A study conducted by Cabansag (2015) entitled "Impact Statements on the K to 12 Science Program in the Enhanced Basic Education Curriculum in Provincial Schools" concluded that science as one of the core subjects and specializations in academic will prepare students in the science related degrees and will equip them with competencies to meet the demands and standards set by different institutions. The impact statement on the observed increase in performance of knowledge brings a holistic development among learners. Many of the students recognized the increased level of performance that the K to 12 science program claim to realize; this thinking could be traced from what they actually experience since the mix of their science subject consist of the science lessons offered in higher levels in secondary school. The impact of the program among students also dealt with the provision of learning activities, use of technology in the delivery of instruction and of lessons in increasing difficulty which is a characteristic of the spiral progression of topics.

The study of Cabansag (2015) reveal that learning is more interesting, effective and enjoyable in the K to 12 because they learn Chemistry, Physics, Biology and Earth Science all in one year and there are varied learning activities which enhance their talents and skills. Moreover, students find the topics easy at first and gradually become hard but there is a mastery of the topics because they are discussed in their own pace and longer years to study.

The study of Cabansag has relevance to the present study wherein it focuses on the impact statement of different institutions on the observed increase in the K to 12 science curriculum. The same with the present study, it aims to determine on the performance of students under the new curriculum in science.

In addition, Tan (2012) reviewed that few of the bases among others that were mentioned why spiral progression approach was implemented were: high dropout rate, items in international assessment studies such as the Third International Mathematics and Science Study have integrated questions based on spiral approach, science curriculum framework of high performing countries follow a spiral progression and integrated approach that simplifies how science content and processes can be intertwined, promotes learner-centered rather than teacher-centered.

In the article written by Cruz (2012) entitled, "The Curriculum" it emphasizes on the new curriculum that follows spiral progression approach.

According to him, the noticeable change in the new curriculum is the spiral approach that is used in every grade level which only means that the curriculum is not divided into elementary school and high school. This is now vertical articulation or a seamless progression of competencies.

Furthermore, Isagani (2012) added, that the desired outcomes of the new program are defined in terms of expectancies as articulated in the learning standards. Overall, students are expected at the end of grade 10 to demonstrate communicative competence; think intelligently, critically and creatively in life situations; make informed and values-based decisions; perform their civic duties; use resources sustainably; and participate actively in artistic and cultural activities and in the promotion of wellness and lifelong fitness.

In some studies, from U.S and Canada, on "Refocusing Spiral Curriculum" emphasizes that Spiral Curriculum requires that progress is indeed achieved in each year otherwise it becomes circular. Combined with learner - centered, the spiral curriculum can indeed become circular with the students learning the something over and over each year. This happens when an individual student fails to grasp or master to cover the same materials. Remedial intervention does not occur easily when topics are presented to students in mixed fashion. The spiral nature pushes the students into various topics without enough time to master each one.

The above study has similarities with the present study since both studies wants to assess the performance of the students in a learner-centered case.

Another study about spiral progression approach entitled, "The role of Jerome Bruner's Spiral approach in the reformation of the Philippine Educational System" found out that K to 12 Basic Education Program is a major education reform implemented in 2012 in the Philippine. It serves as a response to the urgent need to improve the quality of Philippine Basic Education curriculum for learners to master basic competencies, lengthening the cycle of basic education to cover kindergarten through year 12 (SEAMO INNOTECH, 2012 p.1). The study seeks to discuss the role of Jerome Bruner's spiral approach in the K to 12 Education program in the Philippines. According to SEAMO INNOTECH's K to 12 Toolkit, the new curriculum ensures smooth transition between grade levels and continuum of competencies through spiral progression where learning of knowledge, skills, values and attitudes increase in depth and breadth, ensuring integrated and seamless learning.

The study also accentuates the new science curriculum where it strongly links science and technology, including indigenous technologies to preserve the country's distinct culture. In the old curriculum, science was taught using the discipline - based approach in the most part of high school. In the new curriculum, spiral approach will be applied in teaching science concepts and application in all subjects. SEAMEO INNOTECH's K to 12 states further that concepts and skills in life sciences, physics, chemistry, and earth sciences are presented with increasing levels of complexity from one grade level to another, thus paving the way for deeper understanding of key concepts.

Dibiasio (2005) conducted a study entitled "A Project – Based Spiral Curriculum for Introductory Courses in Chemical Engineering" found out that in Spiral – Taught students display equal or better understanding of basic chemical engineering principles, were better in teams at solving open – ended problems, had higher retention rates, performed better in upper – level course, and were more confident about their choice of chemical engineering as a major. The result of the study believes that frequent open – ended project experiences built around a spiral topic structure were the major reason for profit success.

Moreover, Krenthal (2012) added, that spiral curriculum could be regarded as an extremes design of mixing the sciences. However, De Dios (2013) argued that spiral curriculum can only devote one quarter of a year branch, so then topics student will be exposed per year in each branch of science are severely limited. Each disciplines requires step, to get to intermolecular forces and a molecular understanding of solutions, there are prerequisites. The topics build on top of each other and a quarter is simply not enough time to cover enough to aid the student in another field. It is simply the nature of the subjects. Therefore, learners will require a year to take chemistry before taking biology.

Educators face a dilemma each and every day. Teachers are challenged to prepare students for standardized assessments while still trying to add creativity to the curriculum. Frequently, students express concern merely with what will appear on the upcoming assessment. As teachers they are preparing students for the state test, in hindsight. They need to keep in mind that the learning objectives of science standards entail for the students to remember the content not just for the test but for life – long learning (De Dios).

Coelho (2015) conducted a study entitled "Student Perceptions of a Spiral Curriculum" concluded that students perceptions of integrated spiral curriculum, and whilst predominantly positive, there are challenges to enhance the student's experience. The spiral curriculum provides an opportunity to revisit and consolidate learning to the apparent benefit of the student.

The two studies are somewhat related because it gives the educational system knowledge and perceptions on the new implemented curriculum in science.

In a study by Adams and Targent (2012), they discussed the different perceptions of students in the curriculum change that happened in China. The Chinese government also made a move to change their curriculum form subject-centered to student-centered scheme. Their study showed that the curriculum change in China reduced the student stress level but increased in student participation. With these results gathered, it is assumed that the new curriculum entails a better way of learning for students since their perception of the curriculum has significantly shifted from the traditional to the new one.

The idea of learning progressions is used to determine how these educative experiences should be organized and is grounded in Dewey's ideas and further developed in Bruner's (1960) notion of the spiral curriculum. As spiral curriculum develops, it repeatedly revisits basic ideas, building upon them each time and allowing the learner to reconstruct his or her previous experiences. The goal is to challenge the learner as the curriculum becomes progressively more advanced and as time goes on and ideas are revisited. In the case of science teaching, the curriculum for learning to teach should be built around the core components of what it means to teach science to students in ways that allow them to develop a deep understanding of the content.

According to the K to 12 Curriculum Guide Science (2013), the aim of the science curriculum is to produce scientifically literate citizens who are informed and active participants of the society, responsible decision makers, and apply scientific knowledge that will significantly impact the society and the environment. The science curriculum is designed to enhance three learning domains of the students; these are the scientific processes and skills, understanding and applying scientific knowledge, and developing scientific attitudes and values.

In as much as the studies reviewed thus the researchers' insights in the conduct of the present study. They differ however, in their nature, other variates involved and research procedures employed.

Chapter 3

METHODOLOGY

This chapter discusses the research design, instrument used in data gathering validation of the instrument, sampling procedure, data gathering procedure and statistical analysis of data.

Research Design

This study utilized a qualitative and quantitative descriptive research, to know the level of performance of senior high school students in terms of developing scientific understanding and acquiring science process skills and their experiences under spiral progression approach in the K to 12 Science Curriculum and the profile variates of student-respondents.

Descriptive and inferential statistical tools was used in the analysis of data such as frequency count, percentage, mean, weighted mean, Pearson product moment correlation, standard deviation and z-test for independent sample.

Instrumentation

This study used a fifty- item multiple choice test questions, survey questionnaire and Focused Group Discussion as the main data gathering instrument in obtaining all the needed information in coming up with the most accurate findings with the level of performance of senior high school students in physical science under spiral progression approach.

Questionnaire

The questionnaire for the student-respondent was consists of three parts. Part I solicited student-respondent's profile like age, sex, track or specialization, grades in physical science in the first quarter for the second semester and average monthly family income.

Part II was composed of a 50-item multiple choice test questions to measure the level of scientific understanding of the student-respondents in physical science under spiral progression approach. The multiple choice test questions were provided by a table of specifications.

Part III of the questionnaire was composed of 28 statements which measures the level of scientific process skills of senior high school students under spiral progression approach. The 28 statements were divided into five skills that classifies scientific process skills; statements 1 to 6 were observation skills; statements 7 to 12 were experimentation, statements 13 to 18 were measurement skills, statements 19-23 were communication skills and statements 24 to 28 were inference skills. The level of scientific process skills were assessed using a rating scale numbered 1 – 4, corresponding to Very Low (VL=1), Low (L=2), High (H=3) and Very High (VH=4), respectively. The instrument was adapted from the study of Omiko Akani (2015) in Nigeria.

The focused group discussion instrument was composed of six questions soliciting student-respondents' experiences under spiral progression approach in science curriculum.

Validation of Instrument

The 50-item multiple choice test questions was constructed by the researcher and it was passed through validations. The questionnaire was drafted and submitted to the five members of the panel for comments and suggestions. All comments and suggestions of the members of the panel were considered and incorporated which was subjected to expert validation.

To ascertain the reliability of the questionnaire, it was subjected to pilot testing using the test-retest method through a group of senior high school students from Ramon T. Diaz National High School who were not samples of this study, wherein the coefficient reliability was computed using Cronbach's alpha formula. The computed value denoted the reliability coefficient that determined the strength of the questionnaire. Interpretation of the reliability was based on the information below:

Reliability Coefficient	Degree of Reliability
0.90	Excellent
0.80 - 0.90	Good
0.70 - 0.80	Respectable
0.65 - 0.70	Minimally Acceptable
0.60 - 0.65	Undesirable
0.60 below	Unacceptable

The computed reliability coefficient was 0.84 which was denoted that the questionnaire possessed good reliability suggesting that the questionnaire was adequate for individual measurement, particularly on the level of scientific understanding of the grade 12 senior high school students under spiral progression approach of the K to 12 Science Curriculum.

Whereas, the science process skills questionnaire was adapted from the study of Omiko Akani (2015); and the researcher constructed a Focused Group Discussion Tool in conducting the interview to the respondents with the help also of the research consultant.

Sampling Procedure

The respondents this study were the Grade 12 Senior High School Students of Ramon T. Diaz National High School (RTDNHS), Gandara Samar.

The researcher used stratified random sampling technique in obtaining the necessary information form the respondent. Sample size was determined using Sloven's formula. Table 1 shows the frame of the study.

Data Gathering Procedure

The researcher wrote a letter of approval to the principal of Ramon T. Diaz National High School in Gandara, Samar asking permission to administer the questionnaire and conduct a focused group discussion to the target respondents. The letter of approval was also presented to other authorities involved in this study. After the approval of the letter, the researcher immediately administered the questionnaire to the grade 12 students. After one hour the researcher

Table 1

Sampling Frame

Track or Specialization	Population			Sample Size		
	M	F	Total	M	F	Total
Accountancy, Business and Management (ABM)	10	17	27	5	8	13
General Academic Strand (GA)	32	58	90	20	25	45
Humanities and Social and Sciences (HUMSS)	7	24	31	5	10	15
TVL - Information, Communications Technology (ICT)	31	52	83	8	33	41
TVL- Cookery	19	57	76	17	21	38
TVL- Electrical, Installation and Maintenance (EIM)	83	0	83	42	0	42
TVL-Dressmaking	3	9	12	3	3	6
Total	**185**	**217**	**402**	**100**	**100**	**200**

collected the test questionnaire and it was followed by a group discussion with fifteen respondents coming from different track or specialization. The researcher recorded the responses of participants' focused-group discussion. The gathering of data was conducted during class hours to ensure that all questionnaires will easily be retrieve.

Statistical Treatment of Data

After retrieving the questionnaire from the respondents, the data were tallied, organized and analyzed with the use of descriptive as well as inferential statistical tools such as frequency count, percentage, mean, weighted mean, Pearson product moment correlation coefficient (Pearson r), standard deviation and t – test for independent sample.

Frequency count and percentage. This was used to present the profile of student – respondents such as age, sex, grades in physical science and average family monthly income.

Mean. This was employed to calculate the averages where the measure is applicable like age and average monthly family income.

Weighted mean. This was used to determine the level of scientific understanding and science process skills of student-respondents under spiral progression approach.

Pearson Product Moment Correlation (Pearson r). This was used to determine the relationships between profile variates of student-respondents and level of scientific understanding; and level of science process skills.

z-test for independent samples. This was used to determine the difference in the level of scientific understanding and level of science process skills between and female.

Chapter 4

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

This chapter presents the analyses of the data obtained and the corresponding interpretation in connection with the specific questions of the study.

Profile of Student – Respondents

The profile of the student-respondents such as age, sex, track or specialization, first quarter grades in science in the second semester and average family monthly income are presented below.

Age and sex. Table 2 shows the distribution of student – respondents according to their age and sex.

Table 2

Age and Sex Distribution of Student-Respondents

Age (years)	Sex				Total	%
	Male	%	Female	%		
17	6	6.00	16	16.00	22	11.00
18	37	37.00	37	37.00	74	37.00
19	33	33.00	28	28.00	61	30.50
20	8	8.00	10	10.00	18	9.00
21	5	5.00	7	7.00	12	6.00
22	8	8.00	2	2.00	10	5.00
23	2	2.00	0	0.00	2	1.00
28	1	1.00	0	0.00	1	0.50
Total	**100**	**100.00**	**100**	**100.00**	**200**	**100**
Percentage	**50.0**		**50.0**		-	-
Mean	**19.10**		**18.61**		**18.86**	-
SD	**1.66**		**1.20**		**1.46**	-

About 74 or 37.00 percent of the student – respondents are 18 years old composed of 37 males and 37 females. This is followed by 61 or 30.50 percent composed of 33 males and 28 females whose ages are 19 years old. The oldest is about one or 0.50 percent who is a male whose age is 28 years old.

The mean age of the student – respondents is 18.86 years old with a standard deviation of 1.46 years. It appears that females are younger than males as supported by the mean age of 19.10 year for the male group and 18.61 year for the female group. This means that with the additional two years in Basic Education of the K to 12 curriculum, student's finishes senior high school at higher age but the eagerness to acquire new knowledge is still the same. According to Clack, et al. (2015), in their study "Age-Related Differences in the Ability to Learn of Students", they found out that young and older adults generally demonstrate a similar ability to learn new things. The study also concluded that the ability to acquire knowledge is largely unaffected by cognitive aging.

Track or specialization. Table 3 shows the distribution of student – respondents according to their chosen track or specialization.

As reflected in Table 3, 46 or 23.5 percent of the student – respondents are from the General Academic Strand. This is followed by the Technical Vocational Livelihood – Information Communication Technology composing of 41 or 20.3 percent and the lowest participants in the study were from the Technical

Vocational Livelihood with specialization in dressmaking with six or 3.00 percent.

Table 3

Track or Specialization Distribution of Student – Respondents

Tracks	f	%
Accountancy, Business and Management (ABM)	13	6.5
TVL- Information, Communication and Technology(ICT)	41	20.5
Humanities and Social Sciences (HUMSS)	15	7.5
TVL- Cookery	37	18.5
TVL- Dressmaking	6	3
TVL- Electrical, Installation and Maintenance(EIM)	42	21
General Academic Strand (GA)	46	23
Total	**200**	**100**

First quarter grades for the second semester. Table 4 is the distribution of the student – respondents' first quarter grades in physical sciences for the second semester.

The table shows that 98 or 49.0 percent of the student – respondents has grades ranges from 85 – 89 indicating that grade 12 student has a very satisfactory performance in physical science. Thirty-eight or 19.0 percent have grades ranges from 90 – 100 which shows that students has an outstanding performance in physical science for the first quarter of the second semester. This is followed by 63 or 31.50 percent whose grades in Physical Sciences ranges from 80 – 84 indicating a satisfactory performance. One or 0.50 percent of the student – respondents has grades ranging from 75 – 79 which is fairly satisfactory.

Table 4

Mid-term Grades in Physical Science of 2nd Semester

Grade	f	%	Interpretation
90 - 100	38	19.00	Outstanding
85 - 89	98	49.00	Very Satisfactory
80 - 84	63	31.50	Satisfactory
75 - 79	1	0.50	Fairly Satisfactory
below 75	0	0.00	Did not meet expectation
Total	**200**	**100**	-
Mean	**86.32**	-	**Very Satisfactory**
SD	**3.81**	-	-

The mean grade of the student – respondents is 86.32 which is very satisfactory. This implies that in the spiral progression approach, students are performing well in science as evidenced by the computed mean value; and as students tends to get a higher grade they become even more motivated to learn (Stan, 2012).

<u>Average family income</u>. In Table 5 shows the average monthly family income of student – respondents.

Table 5

Average Family Monthly Income Distribution of Student-Respondents

Income	f	%
1,000 - 5,999	127	63.5
6,000 - 10,999	66	33
11,000 - 15,999	4	2
16,000 - 20,999	2	1
21,000 - 25,999	0	0
26,000 - 30,999	1	0.5
Total	**200**	**100**
Mean	**Php. 5,205.00**	-
SD	**Php. 3,228.79**	-

As can be seen from the table, 127 or 63.5 percent of the student – respondents have average family income ranging from P1, 000 – 5,999. This is followed by 66 or 33.00 percent from P6, 000 – 10,999, four or 2.00 percent from 11,000 – 15,999. The lowest number is one or 0.5 percent whose family income ranging from P26, 000 – 30,999.00. The computed mean income value is P5, 205.00 with standard deviation of P3, 228.79. Comparing these values with the poverty threshold as per survey of Philippine Statistics Authority (2017), this indicates that the family income shows that their families can't afford to provide the basic needs of their family.

Student – Respondents' Level of Scientific Understanding in Physical Science under Spiral Progression Approach

Table 6 reflects the level of understanding in physical science under spiral progression approach.

Table 6

Student-Respondents' Level of Scientific Understanding

Scores	Level of Scientific Understanding	f	%
37 - 48	High	115	57.50
25 - 36	Moderate	76	38.00
13 - 24	Low	9	4.50
Total	-	**200**	**100.00**
Mean	-	**36.70**	-
SD	-	**5.20**	-

Out of 200 student – respondents' 115 or 57.50 percent have "high" level scientific understanding corresponding to a percentage score 37.48. Seventy-six or 38.00 percent have "moderate" level scientific understanding with percentage scores 25.36 and 9 or 4.50 percent have "low" level of scientific understanding at percentage scores between 13 – 24.

The overall level of scientific understanding of senior high school student – respondents' in physical science under spiral progression approach is "high" as supported by mean percentage score of 36.70 with standard deviation of 5.20. With the results above, it coincides with the approach of spiral progression in science - spiral progression design are presented repeatedly throughout the curriculum, but with deepening layers of complexity and after a mastery of the initial topic, the student spirals upwards as the new knowledge is introduced, enabling the student to reinforce what is already learned. In the end, a rich breadth and depth of knowledge is achieved (Dee, 2014).

Student – Respondents' Level of Science Process Skills in Physical Science under Spiral Progression Approach

The weighted means of the 28 statements used to determine the level of science process skills under spiral progression approach of the student-respondents are presented below.

Based on the results in Table 7, statements one, two and three had mean values that falls in the very high level while statements 4, 5 and 6 had mean values that falls in high level. The grand mean of 3.54 with standard deviation of

0.49 is also within very high level indicating that senior high school students are observant with different things in their environment.

Table 7

Mean and Standard Deviation Results based on Observation Skills

Statements	VH (4)	H (3)	L (2)	VL (1)	X_w	SD	Interpretation
1. Ability to use senses to identify characteristics of properties.	150	48	2	-	3.74	0.46	VH
2. Ability to identify similarities and differences between objects based on features/ properties.	124	75	1	-	3.62	0.38	VH
3. Ability to identify qualitative changes in conditions.	121	70	9	-	3.56	0.49	VH
4. Ability to use observable properties to classify object or parts of organism.	93	105	2	-	3.46	0.50	H
5. Ability to observe quantitative changes in formation of products.	95	97	8	-	3.44	0.55	H
6. Ability to identify differences between substances before and after chemical reaction.	96	99	5	-	3.46	0.54	H
Grand Mean	-	-	-	-	**3.54**	**0.49**	**VH**

Legend: VH – Very High H – High L – Low VL – Very Low

Table 8 shows that in experimentation skills, the mean value for each item is within the high level of the skills of the student-respondents' senior high school students under spiral progression approach. The grand mean of 2.96 with

Table 8

Mean and Standard Deviation Results based on Experimentation

Statements	VH (4)	H (3)	L (2)	VL (1)	X_w	SD	Interpretation
7. Ability to identify instruments for carrying out an experiment.	71	108	21		3.25	0.68	H
8. Ability to set up instruments for experiments.	55	99	42	4	3.03	0.84	H
9. Ability to follow steps or procedures in experiment.	50	98	46	6	2.96	0.83	H
10. Ability to observe precautionary measures when carrying out an experiment.	37	100	50	13	2.81	0.90	H
11. Ability to identify and carry out necessary repetition of steps in experiments.	26	129	28	17	2.82	0.88	H
12, Ability to work independently.	38	119	25	18	2.89	0.99	H
Grand Mean	-	-	-	-	**2.96**	**0.85**	**H**

Legend: VH – Very High H – High L – Low VL – Very Low

standard deviation of 0.86 is also within the range of high level skills in experimentation. This indicates that students have the ability to conduct experiments following the necessary precautions and procedures.

Table 9

Mean and Standard Deviation Results based on Measurement Skills

Statements	VH (4)	H (3)	L (2)	VL (1)	X_w	SD	Interpretation
13. Ability to determine appropriate values using average value of measures.	75	113	12	0	3.32	0.62	H
14. Ability to identify appropriate device for measuring quantities.	64	126	10	0	3.27	0.49	H
15. Ability to use measuring instruments correctly.	79	106	10	5	3.30	0.79	H
16. Ability to repeat measurement to obtain more appropriate value.	87	92	19	2	3.32	0.61	H
17. Ability to specify units of measurements using the correct S.I units (metric system)	95	88	15	2	3.38	0.48	H
18. Ability to estimate quantity using the spatula.	58	116	22	4	3.14	0.63	H
Grand Mean	-	-	-	-	**3.29**	**0.60**	**H**

Legend: VH – Very High H – High L – Low VL – Very Low

In the above table, the values for each of the item were found to be in the high level. The grand mean value of 3.29 with standard deviation of 0.60 is also within the high level skills in the experimentation. This indicates that with the use of spiral progression approach students can measure or estimate a particular dimensions or objects.

Table 10

Mean and Standard Deviation Results based on Communication Skills

Statements	VH (4)	H (3)	L (2)	VL (1)	X_w	SD	Interpretation
19. Ability to express observation in quantitative description.	88	90	20	2	3.42	0.80	H
20. Ability to use written reports to transmit information.	93	99	8	0	3.47	0.56	H
21. Ability to express observations in appropriate quantitative description.	85	107	8		3.43	0.56	H
22. Ability to report event procedurally.	77	112	9	2	3.37	0.62	H
23. Ability to use appropriate reporting format for the type of observation or event.	102	87	11	0	3.51	0.54	VH
Grand Mean	-	-	-	-	**3.44**	**0.62**	**H**

Legend: VH – Very High *H – High* *L – Low* *VL – Very* Low

As reflected in Table 10, only statement 23 had mean value that falls into very high level in terms of the communication skills acquired by the grade 12 students, while statement 19, 20, 21 and 22 falls into high level of communication skills. The grand mean of 3.44 with standard deviation of 0.62 also falls in high level skills of communication. This means that in the K to 12 science curriculum applying the spiral progression approach the students gained the ability in expressing observations into a particular condition in science-related topics.

Table 11

Mean and Standard Deviation Results based on Inference Skills

Statements	VH (4)	H (3)	L (2)	VL (1)	X_w	SD	Interpretation
24. Ability to make assumptions based on observations	120	78	2	0	3.59	0.48	VH
25. Ability to relate the observed characteristics and experimental results	94	95	11	0	3.42	0.61	H
26. Ability to draw reasonable conclusions bases on results.	77	105	12	6	3.27	0.77	H
27. Ability to relate initial assumptions with experimental results.	88	98	14	0	3.37	0.51	H
28. Ability to specify relevant conclusion at each stage of experimentation.	77	104	13	6	3.26	0.79	H
Grand Mean	**-**	**-**	**-**	**-**	**3.38**	**0.63**	**H**

Legend: VH – Very High H – High L – Low VL – Very Low

In the above table, statement 24 had mean value that falls into very high level of inference skills acquired by the students while statement 25, 26, 27 and 28 falls into high level skills of inference. The grand mean of 3.38 with standard deviation of 0.63 falls into high level skills. This indicates that in the spiral progression approach students can figure out things based on their observations and can determine what is observed and what is already known.

Relationship Between Student-Respondents' Scientific Understanding in Physical Science and Profile Variates

Table 12 below provides the coefficients of correlation and p-values between student-respondents 'scientific understanding and their profile variates.

Table 12

Correlation Between Student-Respondents' Scientific Understanding in Physical Science and Profile Variates

Profile Variates	r_{xy}	p-value	Decision	Evaluation
Age	0.053	0.457	Accept Ho	NS
Grades in Science	0.393	0.000	Reject Ho	**S**
Average Monthly Family Income	0.033	0.644	Reject Ho	**S**
Track or specialization	0.203	0.004	Accept Ho	NS

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

The following correlation coefficients and p-values were obtained between student-respondents' scientific understanding under spiral progression approach and profile variates: 0.393 and 0.000 for grades in physical science and 0.033 and 0.644 with average monthly family income. The accompanying p-values are lower than the 0.05 significance level which means significant relation between variables. Therefore, the hypotheses "there is no significant relationship between scientific understanding in the spiral progression approach and grades in science and average monthly family income" is rejected. This implies that in the spiral progression approach, grades and average family monthly income are significantly related to each other, this means that as the students' level of scientific understanding gets higher the grades of the students will also become higher since they will be able to perform well in their science subject.

In contrast, the following coefficients of correlation and p-values were obtained from the remaining profile variates: 0.053 and 0.457 with age and 0.203 and 0.004 for track or specialization. The p-values are higher than the 0.05 significance level implying no significant relationship between variables. The hypotheses "there is no significant relationship between student-respondents' scientific understanding under spiral progression approach and age and track or specialization" is accepted. This indicates that age and track or specializations are not significantly related to the students' level of scientific understanding. This means that whatever track or specialization the student may choose in the senior high school program and regardless of age it does not affect the level of scientific understanding of the student.

Relationship Between Student-Respondents' Science Process Skills in Physical Science and Profile Variates

Table 13 shows the correlation between the different profile variates and level of science process skills of the grade 12 senior high school students in their subject physical science under spiral progression approach in the K to 12 science curriculum.

Table 13

Correlation Between Student-Respondents' Science Process Skills in Physical Science and Profile Variates

Level of Science Process Skills		Age	Grade in Science	Average Monthly Family Income	Track
Observation Skills	r_{xy}	0.154	0.032	0.003	0.345
	p-value	0.030	.652	.963	5.5E-07
	Evaluation	S	NS	NS	S
Experimentation	r_{xy}	0.208	-0.124	-0.084	-0.405
	p-value	0.003	0.079	0.237	2.7E-09
	Evaluation	S	NS	NS	S
Measurement Skills	r_{xy}	0.080	0.062	0.071	0.388
	p-value	0.258	0.384	0.318	1.4E-08
	Evaluation	NS	NS	NS	S
Communication Skills	r_{xy}	0.024	0.139	-0.132	0.236
	p-value	0.734	0.049	0.063	0.00075
	Evaluation	NS	S	NS	S
Inference Skills	r_{xy}	-0.044	0.003	0.036	0.411
	p-value	0.533	0.969	0.613	1.5E-09
	Evaluation	NS	NS	NS	S

As depicted in the table, in the level of science process skills of the student-respondents', the observation and experimentation skills have significant relationship with their age and the track they have chosen as evidenced in the computed p-values thus rejecting the hypothesis. Hence, the levels of science process skills in observation have significant relationship with their age and track or specialization. This means that as the higher the age of the students' they tend to be more observant and has the ability to conduct experiments procedurally and their level of science process skills in observing differ in the track or specialization they have chosen. Their grades in science and average monthly income were found to have no significant relationship as evidenced in the p-values with their level of science process skills in observation thus accepting the hypothesis.

In the measurement skills of the student-respondents' only the track or specialization have significant relationship with the level of science process skills in measurement while their age, grades and average family monthly income were found to have no significant relationship with their level of science process skills in measurement thus accepting the hypothesis. Hence, there is no significant relationship with the student-respondents' age, grades, and average family monthly income to their level of science process skill in measurement; in the communication and inference skills, their age grades and track have significant relationship with their communication skills as evidenced by the p-values, thus rejecting the hypothesis. This means that as the student-respondents' gets a higher grades in physical sciences they are more confident in expressing their ideas on a particular conditions in science-related topics; and in the inference skills , only the track were found to be significant to their inference level of science process skills.

Difference in Scientific Understanding in the Spiral Progression Approach Between Male and Female

Table 14

Comparison of Scientific Understanding Between Male and Female in the Spiral Progression Approach

Level of Scientific Understanding	Sex	Mean	SD	z - value		Evaluation
				Computed	Critical	
scores	Male	37.110	5.140	1.596	1.96	Accept H_o/ NS
	Female	36.280	5.259			

Reject H_o/computed z/ $\geq$ critical, z = 1.96
Accept H_o/computed z/ $\leq$ critical, z = 1.96

Table 14 shows the mean values of males and females on their level of scientific understanding. The males had mean value of 37.110 with standard deviation of 5.140 while the females had mean value of 36.280. The analysis indicates a z-critical value of less than 1.96, showing that there is no significant difference between male and female on their level of scientific understanding thus accepting the hypotheses. Hence, the level of scientific understanding of the student-respondents' has no significant difference as to male or female. This indicates that the students can acquire the level of scientific understanding in the spiral progression approach regardless of gender.

Difference in Science Process Skills in Spiral Progression Approach Between Male and Female

Table 15

Comparison of Science Process Skills Between Male and Female in the Spiral Progression Approach

Level of Science Process Skills	Sex	Mean	SD	z - value		Evaluation
				Computed	Critical	
Observation Skills	Male	3.600	0.238	1.661	1.96	Accept H_o/ NS
	Female	3.487	0.295			
Experimentation	Male	2.979	0.493	0.824	1.96	Accept H_o/ NS
	Female	2.937	0.519			
Measurement Skills	Male	3.327	0.389	2.158	1.96	**Reject H_o/ S**
	Female	3.245	0.370			
Communication Skills	Male	3.400	0.329	1.086	1.96	Accept H_o/ NS
	Female	3.362	0.365			
Inference Skills	Male	3.382	0.443	0.096	1.96	Accept H_o/ NS
	Female	3.378	0.390			

Reject H_o/computed z / $\geq$ critical, z = 1.96
Accept H_o/computed z / $\leq$ critical, z = 1.96

As shown in the above table, among the five skills of science processes only the measurement skills have showed a significant difference between male and female. With the computed mean value of 3.327 for male and 3.245 for females, analysis shows that there is a significant difference as to the measurement skills of male and female. From the computed mean values, it implies that male respondents are likely to be more precise in terms of measurements rather than female in different conditions such as the ability to determine appropriate values using values of measurement; and the other science process skills like experimentation, observation, communication and inference skills were found to have no significant difference as to male or female. This further meant that the mentioned science process skills of grade 12 student-respondents' does not vary significantly in male and female in the spiral progression approach of the K to 12 science curriculum.

Experiences of Student-Respondents in Spiral Progression Approach of the K to 12 Science Curriculum

Table 16 below summarizes the responses of the student-respondents on their experiences of going through spiral progression approach in the new science curriculum design of the K to 12 Program.

Fifteen or 100 percent of the student-respondents agreed that they are aware with the new changes in science curriculum - the spiral progression approach and the integration of the four areas of science all in one grade level. All the respondents in the focused group discussion responded that spiral progression approach is a step by step process which starts from the very basic

Table 16

Responses of the Students on their experiences of Spiral Progression Approach

Responses of the Students	f	%
1. We are aware with the changes in the science curriculum, such as the integration of the four areas in science in one grade level.	15	100
2. I defined spiral progression as the step by step process which starts from the very basic up to complex.	15	100
3. There is a connection of topics in every grade level.	9	60
In a spiral progression approach as the learning progresses, more and more details are being introduced.	6	40
4. I acquired the scientific knowledge and understanding through various activities in our science subject.	15	100
5. We are bombarded with knowledge in every grade level since it becomes difficult as we go to a higher grade level. The lesson is being cut or stop after the allocated time hence students cannot fully understand a specific topic in science.	15	100
Our school lacks learning materials and facilities in science.	15	100
Our science teacher uses limited strategies in teaching us in science.	13	86
6. We are in favor of spiral progression approach in science, it is in fact advantageous to us because the content of the science subjects are already advanced and activities are interesting and new to us.	15	100

up the complex one. Nine or 60 percent responded that spiral progression is a connection of topics in every grade level and the remaining six or 40 percent agreed that in the spiral progression approach, as the learning progresses, more details are being introduced. According also to the fifteen student-respondents, it is through various activities in science they can acquire scientific knowledge and understanding. The student-respondents' also mention that they also encountered problems in a spiral progression approach like they are being bombarded with knowledge every grade level and the transition of topics every grade level is somewhat not evident because the time allocated for each is limited. The student-respondents also raised on the lack of learning materials in science, the same with the equipment's and facilities. They also point out the strategies used by some of the science teachers; most of the teachers use limited strategies in teaching science.

As a whole, the student-respondents disclosed that in the science content and processes of the K to 12 curriculum are intertwined, organized, arouse student's curiosity and motivate them to learn and appreciate science as relevant and useful subject; and through hands-on and minds-on activities it used to develop student's interest and become active learners.

Chapter 5

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of major findings, the conclusions drawn and the recommendations that were formulated based on the results of the study.

Summary of Findings

Based on the analyses and interpretation of the data gathered, the following results were obtained:

1. The average age of the student-respondents was 18.86 years old with standard deviation of 1.46 years.

2. There were 100 males and 100 females.

3. Majority of the Grade 12 senior high school student-respondents' were enrolled in General Academic Strand (GAS).

4. Majority of the students has a very satisfactory grade in physical science for the first quarter of second semester.

5. Majority of the student-respondents has an average family monthly income between P1,000 – P5,999. The mean average family income was P5,205 with standard deviation of P3,228.79.

6. The student-respondents has "high" level scientific understanding in physical science under spiral progression approach as evidenced by mean of

36.70 with standard deviation of 5.20. This indicates that student excel in their science subject in the K to 12 Science Curriculum.

7. In the level of science process skills, the student-respondents has a "very high" level on observation skills as evidenced by the grand mean of 3.54 with standard deviation of 0.49. This indicates that under spiral progression approach the student-respondents' are observant in identifying changes in science-related topics.

8. The student-respondents has "high" level skills in experimentation as evidenced by the grand mean of 2.96 with a standard deviation of 0.85 indicating that student-respondents can identify instruments and has the ability to follow steps or procedures in experiment.

9. The student-respondents has "high" level skills of measurement in the science process skills given by its grand mean value of 3.29 with standard deviation of 0.60 implying that students has the ability to determine appropriate values using average value of measures.

10. "High" level of communication skills are being possessed by the student-respondents in the science process skills as evidence of the grand mean of 3.4 with standard deviation of 0.6 indicating that the student-respondents has the ability to express observation in a certain event procedurally.

11. The student-respondents has "high" level of inference in science process skills as given in the grand mean value of 3.38 with standard deviation of

0.63 indicating that students has the ability to make assumptions based on observations.

12. The level of scientific understanding of the student-respondents were not affected by the age and track or specialization as evidenced by the p-values of 0.457 for age and 0.004 for tack or specialization which were evaluated as not significant and thus accepting the hypothesis. The student-respondents' grade and average family monthly income were found out be significant as evidenced by the p-value of 0.000 for their grades and 0.644 for average family monthly income at 0.05 level of significance which led to the rejection of the hypothesis. Hence, the level of scientific understanding of the student-respondents has significant relationship with their grades and average family monthly income.

13. In the level of science process skills of the student-respondents', the observation and experimentation skills have significant relationship with their age and the track or specialization they have chosen as evidenced in the computed p-values. Hence, the levels of science process skills in observation have significant relationship with their age and track or specialization while their grades in science and average monthly income were found to have no significant relationship as evidenced in the p-values with their level of science process skills in observation. In the measurement skills of the student-respondents' only the track or specialization have significant relationship with the level of science process skills in measurement while their age, grades and average family

monthly income were found to have no significant relationship with their level of science process skills in measurement. Hence, there is no significant relationship with the student-respondents' age, grades, and average family monthly income to their level of science process skill in measurement; in the communication and inference skills, their age grades and track have significant relationship with their communication skills as evidenced by the p-values.

14. No significant difference was found out between the scientific understanding of male and female under spiral progression approach. This was supported by the z- critical value of less than 1.96. So, the hypothesis "there is no significant difference in the level of scientific understanding of male and female" was accepted.

15. Among the five science process skills only the measurement skills was found out to have a significant difference between male and female. It was supported by the computed mean value of 3.327 for males and 3.245 for females which shows a significant difference as to the measurement skill of both sexes; while the other process skills like experimentation, observation, communication and inference skills were found to have no significant difference between male and female.

16. Fifteen or 100 percent of the student-respondents agreed that they are aware with the new changes in science curriculum - the spiral progression approach and the integration of the four areas of science all in one grade level. All the respondents in the focused group discussion responded that spiral

progression approach is a step by step process which starts from the very basic up the complex one. Nine or 60 percent responded that spiral progression is a connection of topics in every grade level and the remaining six or 40 percent agreed that in the spiral progression approach, as the learning progresses, more details are being introduced. According also to the fifteen student-respondents, it is through various activities in science they can acquire scientific knowledge and understanding. The student-respondents' also mention that they also encountered problems in a spiral progression approach like they are being bombarded with knowledge every grade level and the transition of topics every grade level is somewhat not evident because the time allocated for each is limited. The student-respondents also raised on the lack of learning materials in science, the same with the equipment's and facilities. They also point out the strategies used by some of the science teachers; most of the teachers use limited strategies in teaching science.

Conclusions

The following are the conclusions derived from the findings enumerated above:

1. Majority of the student-respondents are 19 years old, most of them are enrolled in General Academic Strand, and parents earning on average monthly family income at P1, 000 – 5,999. This indicates that the parents of the

student-respondents based from the poverty threshold set by PSA (2017) belong to the poor family.

2. Overall, the student-respondents have high level scientific understanding based on the scores from the multiple choice test, indicating that students has better understanding on the content of the new design curriculum in science.

3. Student-respondents' scientific understanding under spiral progression approach was significantly related with average family monthly income and grades in physical science but not with age and tack or specialization. This indicates that as student' level of understanding gets higher students will also get good grades since they are able to perform well in science classes.

4. There was no significant difference on the scientific understanding between male and female under spiral progression approach indicating that the students can acquire the level of scientific understanding in the spiral progression approach regardless of gender.

5. As a whole, the student-respondents' rated "high" on the level of science process skills acquired by the respondents, that only means that varied activities in the science curriculum of the k to 12 program are effective.

6. In the level of science process skills of the student-respondents, observation and experimentation skills is significantly related to age and track or specialization but not with their grades in physical science and average family

monthly income. This means that as the higher the age of the students' they tend to be more observant and has the ability to conduct experiments procedurally and their level of science process skills in observing differ in the track or specialization they have chosen; measurement skills is significantly related to their track but not with their age, grades in physical science and average family monthly income; communication skills is significantly related to their grades in science and track or specialization but not with age and average family monthly income; and inference skills is significantly related to their track or specialization but not with age, grades in science and average family monthly income.

7. Among the five science process skills, only the measurement skills has significant difference between male and female while the other science process skills has no difference significantly. This implies that male are likely to be precise in terms of measurements rather than female in different conditions such as the ability to determine appropriate values using values of measurement.

8. From the responses of fifteen students interviewed they agreed that they are aware with the new changes in science curriculum - the spiral progression approach and the integration of the four areas of science all in one grade level. They had defined spiral progression approach as a step by step process which starts from the very basic to difficult. The student-respondents also added that it is through various activities in science they can acquire scientific knowledge and understanding. The student-respondents' also enumerated problems they encountered in spiral progression approach like they

are being bombarded with knowledge every grade level and the transition of topics every grade level is not evident because the time allocated is limited.

Recommendations

1. Educational leaders should continue to reach out to parents even they are unresponsive; continue various advocacy in eliminating poverty and initiate help to strengthen the "Pantawid Pamilyang Pilipino Program" of the government.

2. Teachers should have mastery of content as to the new science curriculum, understand learners and pedagogy design and monitor student's science learning experiences to sustain high level of scientific understanding.

3. The school should provide the necessary equipment's and apparatuses in science for the student's laboratory activities that would support their learning's and for the students to develop various process skills in science.

4. Teachers' must be sent to trainings, seminars, workshops and all about the new approach being used in the science curriculum for them to be equipped with the necessary knowledge in teaching their students.

5. It is recommended to have another study by improving some variables of interest.

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APPENDICES

APPENDIX A

LETTER OF APPROVAL

Republic of the Philippines
Samar State University
COLLEGE OF GRADUATE STUDIES
Catbalogan, City

February 7, 2018

ALVIN A. AGUIRRE, Ph. D.
Secondary School Principal IV
Ramon T. Diaz National High School
Gandara, Samar

Sir,

In partial fulfillment of the Degree Master of Arts in Teaching major in Physics at Samar State University, the researcher is conducting a thesis entitled, **"PERFORMANCE OF SENIOR HIGH SCHOOL STUDENTS IN SPIRAL PROGRESSION APPROACH OF THE K TO 12 SCIENCE CURRICULUM".**

The researcher is in the process of gathering data that will be used in the study. Regarding this issue, the researcher would like to ask from your good office your approval to distribute the survey questionnaire to the Grade 12 students in your school since they are the main respondents of this study and that they are of great help in obtaining information's that the researcher will be needing.

Your consent at this request is greatly appreciated.

Thank you for your time and positive action.

Sincerely yours,
(SGD.) MYRNIEL B. GAL
Researcher

Noted:
(SGD.) FELISA E. GOMBA, Ph. D.
Dean, College of Graduate Studies

APPENDIX B

COVER LETTER FOR THE STUDENT-RESPONDENTS

Republic of the Philippines
Samar State University
COLLEGE OF GRADUATE STUDIES
Catbalogan, City

Dear Respondents,

Greetings!

The undersigned is currently conducting a study entitled **"PERFORMANCE OF SENIOR HIGH SCHOOL STUDENTS IN SPIRAL PROGRESSION APPROACH OF THE K TO 12 SCIENCE CURRICULUM"** as a requirement to complete my degree leading to Master of Arts in Teaching Physics at the Samar State University (SSU), Catbalogan City, Samar.

In line with this, we have chosen you to be one of our respondents of this study and we hope that you will take time answering the questions honestly. Rest assured that all data gathered will be treated with utmost confidentiality and will be used for the purpose of this research endeavor.

Thank you very much for your support and cooperation!

Very truly yours,

MYRNIEL B. GAL
Researcher

TABLE OF SPECIFICATIONS
Physical Science - Grade 12

	COMPETENCIES	NO. OF DAYS	PERCENTAGE	EASY (70%)		AVERAGE (20%)		DIFFICULT (10%)		Total
				Remembering	Understanding	Applying	Analyzing	Synthesizing	Creating	
1	Light elements in Big Bang Theory	3	13	1,2,3	4	5	0	6	0	6
2	Star Formation and Evolution	3	13	7,8	9,10	0	11	12	0	6
3	Nuclear Fusion reaction in Stars	3	13	13,14	15,16	17	0	18	0	6
4	Contributions of the Alchemists to the science of Chemistry	2	9	19,20	21,22	23	0	0	0	5
5	Atom and its sub-atomic particles	3	13	24,25	26,27	28	0	29	0	6
6	Contributions of Thomson, Rutherford, Mosely and Bohr to the understanding of the structure of the atom	3	13	30,31,32	33	34	35	36	0	7
7	Nuclear Model of Atom	2	9	37,38,39	40	41	0	0	0	5
8	Contribution of John Dalton toward the understanding of the concept of the chemical elements	2	9	42,43,44	45	46	0	0	0	5
9	Polar or Non- Polar	1	4	47	0	48	0	0	0	2
10	Types of Intermolecular Forces	1	4	49	0	50	0	0	0	2
	Total	23	100	22	12	9	2	5	0	50

Prepared by:

MYRNIEL B. GAL

APPENDIX C

QUESTIONNAIRE FOR THE STUDENT-RESPONDENTS

Part I. RESPONDENTS' PERSONAL PROFILE

Direction: Answer the following items pertaining to your personal profile by filling in the needed information or by putting a check (/) mark on the spaces provided.

Name:______________________________ Age: ____________________
Track/Specialization:_______________ Sex: _____________________
Mid-term grades in Science for second semester: ____________
Average Monthly Family Income:___________

PART II. Level of Scientific Understanding

Multiple Choice. Please read each questions carefully then circle only the letter of the correct answer.

1. What does Big Bang Theory explains?
   a. Why the universe was created. c. Law of Gravity
   b. Origin of the universe. d. The beginning of life.

2. In red shift, the wavelengths of light become ___________.
   a. longer b. faster c. bluer d. shorter

3. What were the first elements formed after the Big Bang?
   a. Lithium and Boron c. Hydrogen and Helium
   b. Carbon and Nitrogen d. Gold and Iron

4. Which of the following is evidence of the Big Bang Theory?
   a. The universe is getting smaller.
   b. The universe isn't moving.
   c. Cavemen heard a loud bang at the beginning of time.
   d. The universe is expanding.

5. What does the Big Bang Theory say?
   a. All of the matter in the universe exploded from a tiny, dense point.
   b. The universe is collapsing and getting smaller.

c. Two galaxies collided causing a big bang.
d. The universe was created in its current location.

6. Why is the Big Bang Theory the most accepted theory for how the universe was formed?
   a. Science has proven it beyond doubt.
   b. A small group of scientists said it was the best opinion.
   c. It is the simplest explanation for the evidence we have.
   d. Because it was created in its current location.

7. The stars in space are ________________.
   a. uniformly spread out
   b. distributed completely at random
   c. chiefly in the Milky Way
   d. mostly contained within widely separated galaxies

8. What is true about nuclear fusion?
   a. It occurs inside stars and inside planets.
   b. It occurs inside the sun but not in other stars.
   c. It occurs in planets but not in star.
   d. It occurs in the sun and stars but not in planets.

9. During the evolution of a star, what event takes at least a million years to occur?
   a. Final contraction c. Successive contraction
   b. Initial contraction d. Secondary contraction

10. The gaseous body that continues to form now appears as a large red object called a ____.
    a. Red star port b. Protostar c. Red giant d. Red dwarf

11. Current ideas suggest that what is responsible for the observed properties of a quasar is a massive ____.
    a. neutron star b. black hole c. spiral galaxy d. star cluster

12. Consider a star embedded at the center of a large low density spherical gas cloud. From which view would see an absorption spectrum?
    a. Looking through the cloud with the light bulb along our sight line.
    b. Looking through the edge of the cloud with the light bulb along our sight line.
    c. Along all line of sight through the cloud.
    d. None of the above.

13. All of the following are involved in carrying energy outward from a stars' core except:
    a. Convection
    b. Radioactive diffusion
    c. Conduction
    d. Neutrinos

14. Which of the following properties make flare stars so active?
    a. Fast rotation rates
    b. deep convection zone
    c. Convecting cores
    d. Both A and B

15. Two stars in a binary star system orbit about their center of mass in orbits that are approximately circular. The distance of star A from the center of mass is quite a lot bigger than the distance of star B form the center of mass. We can conclude that _____.
    a. Star A is heavier than star B.
    b. Star A is hotter than star B.
    c. Star A is lighter than star B.
    d. Star A is cooler than star B.

16. As a star like the sun exhausts hydrogen in its core, the outer layers of the star ______.
    a. become hotter and more luminous
    b. become cooler and more luminous
    c. become hotter and less luminous
    d. become cooler and less luminous

17. Which two energy sources can help a star maintain its internal thermal pressure?
    a. Nuclear fusion and gravitational contraction
    b. Nuclear fission and gravitational contraction
    c. Nuclear fusion and nuclear fission
    d. Chemical reactions and gravitational contraction

18. How can astronomers determine whether the unseen companion in an X-ray emitting binary star system is a black hole or a neutron star?
    a. Black holes show up as a black dot and neutron stars show up as a pulsar.
    b. Any binary system having an unseen companion must contain a black hole.
    c. If the mass of the unseen companion exceeds three solar masses, it must be a black hole.
    d. Only neutron stars can emit X- rays; black holes emit nothing.

19. The first person to express the view that matter is composed of minute particles which was the beginning of the first atomic theory was:
    a. Democritus b. Empedocles c. Aristotle d. Sennert

20. What is a scientific hypothesis?
    a. A scientific law.
    b. A previously established fact.
    c. A general, inductive approach to discovering.
    d. A general, unproven statement derived from observations.

21. General relativity theory was proposed by Albert Einstein is a theory of _____.
    a. Gravitation b. electromagnetic field c. light d. zero point energy

22. He is a German-born American theoretical physicist won Nobel Prize for proposing ___.
    a. nuclear shell model
    b. charge coupled device
    c. electroweak unification
    d. electron affinity

23. Which of the following statements about theories is incorrect?
    a. They are supported by observations.
    b. They are above question and should be accepted as stated.
    c. They suggest new avenues of research.
    d. They help to organize a body of data.

24. Which subatomic particle is negatively charged?
    a. positron b. neutron c. proton d. electron

25. Which two particles each have a mass approximately equal to one atomic mass unit?
    a. proton and electron
    b. b. proton and neutron
    c. electron and positron
    d. electron and neutron

26. . Which total mass is the smallest?
    a. the mass of 2 electron
    b. the mass of 1 electron plus the mass of 1 proton
    c. the mass of 1 neutron plus the mass of 1 electron
    d. the mass of 2 neutrons

27. Which statement is true about a proton and an electron?
    a. They have different masses and different charges.
    b. They have different masses and the same charges.
    c. They have the same masses and different charges
    d. They have the same masses and different charges

28. Which conclusion was a direct result of the gold foil experiment?
    a. An electron has properties of both waves and particles.
    b. An atom is mostly empty space with a dense, positively charged nucleus.
    c. An electron has a positive charge and is located inside the nucleus.
    d. An atom is composed of at least three types of subatomic particles.

29. . Which statement best describes electrons?
    a. They are positive subatomic particles and are found in the nucleus.
    b. They are negative subatomic particles and are found surrounding the nucleus.
    c. They are positive subatomic particles and are found surrounding the nucleus.
    d. They are negative subatomic particles and are found in the nucleus.

30. The first model of an atom was given by _______.
    a. N. Bohr b. E. Goldstein c. Rutherford d. J.J. Thompson

For 31-32. An atom has a mass number of 55. Its number of neutrons is the sum of its atomic number and 5.

31. How many protons, electrons and neutrons does this atom have?
    a. 10 protons, 12 electrons, 14 neutrons
    b. 25 protons, 25 electrons, 30 neutrons
    c. 15 protons, 17 electrons, 20 neutrons
    d. 30 protons, 30 electrons, 35 neutrons

32. What is the identity of this atom?
    a. Helium b. Hydrogen c. Manganesed. Boron

33. Who originally proposed the concept that matter was composed of tiny indivisible,
    particles?
    a. Democritus b. Newton c. Oersted d. Ampere

34. Which subatomic particle identifies an atom as that of a particular element?
    a. proton b. neutron c. plasma d. gas

35. Arrange the following subatomic particles in order of increasing mass: neutron, electron and proton.
    a. Electron > proton = neutron
    b. electron < proton=neutron
    c. proton= electron > neutron
    d. proton < electron < neutron

36. Particles which were deflected backwards in Rutherford's experiment were hit upon by ___.
    a. Nucleus b. empty space c. electrons d. none

37. Atomic number is number of _______.
    a. protons (p^+) b. electrons (e^-) c. neutrons (n^0) d. nucleons (p^+ and n^0)

38. According to Rutherford atomic model on whole atom _______.
    a. has positive charge b. has negative charge c. is neutral d. is heavy

39. In Rutherford atomic model alpha particles were stroked on ______.
    a. Aluminum b. gold c. Silver d. Titanium

40. Number of times a p+ is heavier than an e- is _______.
    a. 18 times b. 184 c. 200 times d. 1840 times

41. When two light nuclei combine to form a heavier nucleus, process is said to be ____.
    a. nuclear fission b. nuclear fusion c. nuclear power d. nuclear transmutation

42. Dalton's law of partial pressure has applications in ____.
    a. Metabolism b. excretion c. respiration d. circulation

43. What is the heaviest particle among all the four given particles?
    a. Electron b. meson c. proton d. neutron

44. Maximum number of electrons that can be accommodated in a shell is given by ___.
    a. $2n^2$ b. $2n^3$ c. 2n d. None

45. Which of the following is not a postulate in Dalton's atomic theory?
    a. Atoms consist of electrons, protons, and neutrons.
    b. Atoms of some pairs of elements can combine in different, small, whole number ratios.
    c. Matter is made up of tiny, indivisible atoms.
    d. Atoms combine to form molecules.

46. Energy of electron is zero ____.
    a. near nucleus b. at infinity c. in first orbit d. in last orbit

47. In which of the following molecules do bond dipole moments cancel out leaving the molecule non-polar?
    a. CH_2Br_2 b. CBr_4 c. $CHBr_3$ d. CH_3Br

48. Which of the following molecules is non-polar?
    a. PCl_3 b. CH_3Cl c. NH_3 d. $AlCl_3$

49. In covalent bonds electrons are shared ______.
    a. Independently b. by force c. mutually d. by temperature

50. Instantaneous dipole -induced dipole forces are also known as _____.
    a. London dispersion forces c. Van der Waal forces
    b. Dipole forces d. Liquid forces

Answers' Key:

1. B
2. A
3. B
4. D
5. A
6. C
7. D
8. D
9. B
10. B
11. B
12. A
13. C
14. D
15. C
16. B
17. A
18. C
19. A
20. D
21. A
22. A
23. B
24. D
25. B
26. A
27. A
28. B
29. B
30. D
31. B
32. C
33. A
34. A
35. B
36. A
37. A
38. C
39. B
40. D
41. B
42. C
43. D
44. A
45. A
46. B
47. B
48. D
49. C
50. A

PART III. Level of Science Process Skills among Grade 12 senior high school students under spiral progression approach in the K to 12 Science Curriculum

Observation Skills	Very High	High	Low	Very Low
1. Ability to use senses to identify characteristics of properties.				
2. Ability to identify similarities and differences between objects based on features/ properties.				
3. Ability to identify qualitative changes in conditions.				
4. Ability to use observable properties to classify object or parts of organism.				
5. Ability to observe quantitative changes in formation of products.				
6. Ability to identify differences between substances before and after chemical reaction.				
Experimentation	**Very High**	**High**	**Low**	**Very Low**
7. Ability to identify instruments for carrying out an experiment.				
8. Ability to et up instruments for experiments.				
9. Ability to follow steps or procedures in experiment.				
10. Ability to observe precautionary measures when carrying out an experiment.				
11. Ability to identify and carry out necessary repetition of steps in experiments.				
12. Ability to work independently.				
Measurement Skills	**Very High**	**High**	**Low**	**Very Low**
13. Ability to determine appropriate values using average value of measures.				
14. Ability to identify appropriate device for measuring quantities.				
15. Ability to use measuring instruments correctly.				
16. Ability to repeat measurement to obtain more appropriate value.				
17. Ability to specify units of measurements using the correct S.I units (metric system)				
18. Ability to estimate quantity using the spatula.				
Communication Skills	**Very High**	**High**	**Low**	**Very Low**
19. Ability to express observation in quantitative description.				
20. Ability to use written reports to transmit information.				
21. Ability to express observations in appropriate quantitative description.				

Observation Skills	Very High	High	Low	Very Low
22. Ability to report event procedurally.				
23. Ability to use appropriate reporting format for the type of observation or event.				
Inference Skills	**Very High**	**High**	**Low**	**Very Low**
24. Ability to make assumptions based on observations				
25. Ability to relate the observed characteristics and experimental results				
26. Ability to draw reasonable conclusions bases on results.				
27. Ability to relate initial assumptions with experimental results.				
28. Ability to specify relevant conclusion at each stage of experimentation.				

APPENDIX D

Focused Group Discussion Guide

Introduction:

- Good afternoon! Thank you for agreeing to participate. I am very interested to hear your ideas and experiences about your learning's through spiral progression approach in the K to 12 science curriculum.

- The purpose of this study is to determine the level of performance of the grade 12 senior high school students under spiral progression approach and your experiences with the new design curriculum in science.

- The information you will give to me will keep confidential, and I will not associate your name with anything you say in the focus group.

- I understand how important it is that this information is kept private and confidential.

- If you have any questions or after you have completed the questionnaire, you can always contact me.

- I am Myrniel B. Gal from Samar State University, I am here to administer my questionnaires and at the same time conduct a focus group discussion to selected students of grade 12 senior high school.

- I need to gather information coming from you about your experiences because you are the pioneering batch of the newly implemented curriculum.

- Have you joined any focus group discussion before?

- I am appealing for your cooperation with this focus group discussion to arrive the needed information in the study.

- (Turn on recorder.)

Questions	Expected Responses	Actual Responses
1. Let's start the discussion by talking about the K to 12 Curriculum. Are you aware of the changes in the subject Science in the new K to 12 Curriculum?	-The new changes with the science curriculum is the integration of the four areas in science, Earth Science, Biology, Chemistry and Physics.	
2. Do you have any idea about Spiral Progression?	Spiral Progression is an approach where in basic principles are introduced in the first grade and are rediscovered in succeeding grades in more complex form.	
3. Based on your observations, how is Spiral Progression applied in Science in the K to 12?	Spiral Progression is applied in science where every topic for every grade level is being introduced with complexity as they move on to a higher level.	
4. Are you acquiring the knowledge and scientific skills through the new designed curriculum in Science?	Through the advance content, complexity of topic and varied activities a student can acquire the necessary knowledge and skills in science.	
5. Do you have any problems encountered in your Science subject?	-Lack of learning materials -Limited use of strategies by the teachers -Transition of topics every grade level	
6. Are in favor of Spiral Progression Approach in Science?	-With the new Science curriculum, activities and discussion are more interesting through spiral progression approach. -New curriculum is student-centered.	

- That concludes our focus group. Thank you so much for coming and sharing your thoughts and opinions with me. If you have additional information that you did not get to say in the focus group, please feel free to write it on a piece of paper.

CURRICULUM VITAE

CURRICULUM VITAE

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