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Implementation of Spiral Progression Approach of Teaching Science in Secondary Schools: A Review of Related Literature

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Abstract**—***The Philippines' adoption of the K to 12 curriculum introduced a definite approach to science education known as spiral progression. This method emphasizes revisiting and expanding upon scientific concepts in a progressively complex manner over time. While the theoretical underpinnings of spiral progression are well-established, empirical research on its application in the Philippine context remains limited, particularly in private secondary schools. This study seeks to address this gap by examining how science teachers perceive and implement the spiral curriculum. By evaluating its impact on student learning outcomes and scientific literacy, the study aims to shed light on the effectiveness of the spiral approach in enhancing science education. The spiral progression approach shows promise for engaging and effective science education. However, further research is needed to fully understand its impact on student learning and to optimize its implementation in the classroom.*

Keywords**—** *K to 12 curriculum, Spiral progression, Science education, Philippine context, Student learning outcomes.*

I. INTRODUCTION

The K to 12 curriculums were implemented to improve the education system in the Philippines and to have globally competitive students. The design of the curriculum monitors a spiral progression style across topics by constructing the same ideas in a rising complexity and difficulty starting from primary school. It is predictable from the teachers that they will utilize the spiral approach on their teaching competencies.

Earlier to the enactment of the k to 12 platforms, science has been educated by discipline and each grade level only focuses on one discipline where students master the subject by year. But in the new curriculum, these disciplines are being taught all at the same time in a spiral progression approach per grading period. It focuses on the development of consciousness and comprehension of practical everyday issues affecting the learners' lives as well as the lives of people in their immediate surroundings. It has been suggested that the spiral program could be considered an extreme approach for combining the sciences, as per Kronthal (2012). Although the spiral program may only dedicate one-fourth of a year to each branch, according to De Dios (2013), the number of topics students will be subjected to in each discipline of science per year is significantly constrained.

Learners progress upward in a spiral pattern as scientific knowledge is taught in each subsequent class, allowing them to consolidate what they have already learned. At the conclusion of the day, a broad and deep understanding of the subject matter is gained. This technique allows for a revisiting of the previously taught notion, which aids in the preservation of the information. Aside from that, when the issue is returned, it can be gradually extended, leading to greater knowledge and transfer (Mantiza, 2013).

Objectives

The purpose of this review is to determine the extent to which the spiral development strategy is implemented in science education among secondary schools, specifically focusing on how well it aligns with the content and pedagogical requirements outlined in the K to 12 curriculum guidelines.

Specifically, it sought answers to the following questions:

1. What are the perspectives and instructional practices of private secondary science teachers regarding the spiral progression approach, with a specific focus on their understanding of the theoretical underpinnings of the approach, the instructional methods they employ, and the perceived challenges and benefits associated with its implementation?
2. Does the spiral progression approach affect students' learning outcomes and scientific literacy, with a particular emphasis on measuring changes in student engagement, conceptual understanding, critical thinking skills, and ability to apply scientific knowledge in real-world contexts as a result of exposure to the approach?

II. REVIEW OF RELATED LITERATURE

The implementation of the K to 12 curriculum in the Philippines aimed to enhance the education system and produce globally competitive students. This curriculum follows a spiral progression approach, wherein topics are revisited and built upon with increasing complexity over time. Prior to K to 12, science education was discipline-based, focusing on one discipline per grade level. However, under the new curriculum, all science disciplines are taught simultaneously in a spiral progression approach, integrating practical everyday issues affecting learners' lives. The spiral program has been suggested as an effective method for combining sciences, allowing learners to gain a broad and deep understanding of scientific concepts.

Bruner's Spiral Progression Approach Theory

Jerome Bruner's Spiral Progression Approach Theory served as a foundation for the spiral curriculum, emphasizing learning progression from simple to complex concepts. The curriculum is designed to facilitate students' analytical and decision-making abilities, encouraging deep understanding rather than rote memorization.

As stated by Alegre (2019) when Jerome Bruner developed the theory of Spiral Progression, he did it on the basis of the principles taken from John Dewey. Founded on the behavioral theory presented by Jerome Bruner (1960), he inscribed, "We start with the idea that any topic can be presented in some truthful form to any kid at any level of maturity," the Spiral Process is a method of teaching that has been widely adopted. This means that even very young infants are capable of comprehending even the most concerns raised when it is arranged and given in an appropriate manner (Alegre et. al, 2019).

Bruner opposed Piaget's Notion of willingness. He asserted that schools squander time by attempting to adapt the intricacy of subject matter to children's cognitive stage of maturation, which is not always successful. Because certain themes are thought to be too complex for them to comprehend, pupils may have difficulty understanding particular issues; as a result, those issues must be presented only when an instructor considers that the children has achieved the proper level of cognitive development (Alegre et. al, 2019).

According to Bruner's (1960/1977) suggestion, programs should be built in a spiraling development that progresses from simple to complicated and calls for the review of existing knowledge. For the most part, students continue to add concepts on top of what they already know while returning to the fundamental principles until they have comprehended the whole formal notion. As a result, subjects would be taught at levels of difficulty that steadily increased in complexity over time.

Professor Bruner stressed the advantages that can be gained by enhancing students' powers of analysis, decision making and recall, as well as by increasing their ability to transfer information to other situations (Hatuina, 2013). His theory was that learners should understand the essential concepts of topics and build knowledge on a profound level rather than simply memorizing data, and that they should transfer thinking procedures from each other. learning processes that are repeated over and over (Alegre et. al, 2019).

Spiral Progression Approach

Based on the study of Corpuz (2014), in spiral progression approach basic ideas are learned first and as learning developments, more particulars are presented while at the similar time the particulars are still connected to the essentials which are reemphasized and delivered with more complexity several times for linking and mastery. When using a spiral development strategy, ideas are presented at a young age and re- taught in subsequent years in a more sophisticated manner as the child grows older. It progresses from the micro to the macro scale, and from the simple to the complicated.

Accordingly, the data's scope and chronology are designed so that capabilities are reviewed with greater detail at every elementary school. With each new set of facts and ideas learned about a particular subject, the knowledge expands in both breadth and complexity, resulting in a metaphorical spiral of learning (Corpuz, 2014). Spiral development approach enables students to connect disciplines. There is now "vertical vocalization" or "seamless development" and "horizontal articulation" of aptitudes in the spiral progression technique (Tirol, 2021). Vertical integration links lessons together and connects knowledge from one subject to another during a course of study. It aids in the development of skills and knowledge in pupils that are maintained while new learning components are added. While horizontal articulation combines the information and abilities from several corrections, it shows that what was taught in one subject or test correlates to what is presented in some other (Tirol, 2022).

When the breadth and chronology of the curriculum are produced in such a way that ideas and abilities are explored at each elementary level with different thickness, this is known as a spiral development approach (Ferido, 2013). New ideas are layered on top of students' past knowledge and abilities, allowing them to progress from one elementary level to another with greater ease (Tirol, 2023). A horizontal development (for example, rising complexity) is used in this strategy, rather than a vertical development (for example, increasing difficulty) (e.g. broader range of applications). Each time an idea is revisited, it allows for more extension, reinforcement, and expansion of knowledge (Ferido, 2013).

A variety of activities such as knowledge sharing, peer mentoring, outcome-based achievement or achievement task are included in the new program, according to Angeles (2013). Learners are introduced to interacting, sharing concepts and views or conceptualizing, interacting, and showing their differentiated instruction, abilities, and capabilities in this setting. The spiral progression strategy is referred to as a "student-centered approach" in some circles. In this way, learners who participate in activities led by the teacher, such as peer cooperation and problem-solving skills, will be able to deepen their knowledge of the ideas covered in the subject material.

Science Education before K to 12

According to Orbe et al. Prior to the K–12 school choice, the Basic Education Curriculum (BEC) was implemented in primary and secondary schools in 2002, and the Secondary Education Curriculum (SEC) was established in 2010–2011. The aim of the BEC and the SEC was reading comprehension. The secondary science curriculum was designed to increase students' understanding of the significance of science in their lives, to stimulate creativity and problem-solving skills, and to organize mathematics study in an outdoor environment. Using conceptual knowledge to improve the environment in the future was prioritized over simply knowing about specific scientific topics.

The first year's study of elementary science was expanded upon by integrated research, which brought together themes from physics, biology, chemistry, and earth science in a more logical and systematic order. In the second year, the participants focused on physiology, which covered the

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biological realm of both nonhuman and human beings, social contacts and links with the environment, and the problems we face with regard to health, reproduction, and inheritance, agriculture, resource management, and preservation. The focus of the course was on chemistry, which examined atomic structure, substance reactions, and technologies influencing society and the global environment. The fourth year was devoted to physics, including topics like the fundamentals of physics, kinematics, superior mechanical states of matter, waves and vibrations, magnetism and electricity, as well as contemporary quantum mechanics (DepEd-Bureau of Secondary Education, 2002). The 2010 Secondary Education Curriculum (SEC 2010) employed the same components but followed the Understanding by Design (UbD) framework (Orbe et. al, 2018).

For instance, the Basic Education Curriculum (BEC) and Secondary Education Curriculum (SEC), which were initially implemented in 2010–2011, respectively, were introduced by primary and secondary institutions in 2002 and 2010, respectively, according to Orbe et al. (2018). Both the BEC and SEC made an effort to raise literacy levels. Through the study of mathematics in open spaces and collaborative settings, the secondary science curriculum aims to improve learners' awareness of the value of science in their life and also their analytical, critical thinking, and problem-solving skills. More than simply comprehending science theories, focus was laid on the implementation of these constructs in order to better the sustainability and condition of life for all people. First year incorporated science founded on primary school science by weaving together ideas from earth science, ecology, chemistry, and astronomy that emanated consecutively in a more cohesive and worthwhile sequence of education. By combining concepts from ecology, chemistry, and astronomy, second year science integrated science built on primary school science. Second-year biology classes included the living world of both human and non-human organisms, how people interact with their environment, the problems with health, reproduction, and heredity that we confront, as well as difficulties with food and nutrition security, strategic planning, and preservation. Chemical characteristics and physical behavior of substances, as well as structural characteristics, chemical transformations, and technology's impact on the environment and culture, were the emphasis of the third-year students' studies in chemistry. During their fourth year of study, students focused on physics, covering subjects such the foundations of science, methodology, convection and propelled states of substances, vibrations and vibrations, magnetic and electricity, and modern physics (DepEd-Bureau of Secondary Education, 2002). Similar concepts are used in the 2010 Secondary Education Curriculum (SEC 2010), although the Knowledge by Design (UbD) framework was used instead of the conventional one (Orbe et. al, 2018).

The new K-12 Program in the Philippines

As stated by Orbe et. al, (2018) Under Republic Act No. 10533 (the Enhanced Basic Education Law of 2013) or the Enhanced Basic Australian Journal of Teacher Education Vol 43, 4, April 2018 19 Education Law of 2013, the Department of Education (DepEd) in the Philippines began implementing the new K-12 Program, which began in the 2012-2013 school year. After it's all said and done, the country's educational performance will be determined by the administration's capacity to generate the funds necessary to administer the K-12 program while also addressing the unsolved shortfalls of educational inputs (SEPO Policy Brief, 2011). The arrangement of competences, integration of each science discipline into every primary school, instructive mode, as well as instructive pedagogies, are only a few of the numerous modifications made to the new science instruction (Montebon, 2014). A tight link is established between scientific and technological, original technologies, in order to domain the nation's distinctive philosophy (SEAMEO INNOTECH, 2012). It is a complicated structure that may be understood and evaluated in at least five different dimensions, including learners' learning motivation chemical and science in general. The findings of Salta and Koulougliotis (2012) revealed that motivation is intimately linked to cognition and, as a result, has an impact on science education and the level of science education in students (Orbe et. al, 2018).

Teaching Science

According to Resurreccion and Adanza (2015), the work of a science teacher is one that requires much effort. Not only are they responsible for imparting medical understanding, developing research knowledge, and encouraging scientific views, but they are also responsible for communicating ideas about the process of reality and the job of scientists. Approximately 9 hours are spent learning students, with 4 hours dedicated to lectures and 5 hours dedicated to laboratory time (Wellington and Ireson, 2012). Nevertheless, in Secondary 2002 BEC, the hours each week dedicated to science subjects are divided into two groups of six hours each. In comparison, science is only taught for 4 hours per week in K to 12 education, according to the National Science Education Standards. A recent study conducted by the researchers Almeida et al. (2011) found that the science topic is divided into three types of lessons: speeches, workroom, and tutorial. Discourses give learners with an awareness of the setting in which the material is presented. Discourses should be viewed as hours of active learning that must be completed. Learners must, though, read the assigned reading factual advance in order to be fully effective. When planning lectures, instructors must look for themes that could pose a barrier to students' ability to learn. In order to properly conduct lectures, instructors should identify themes that may cause students to have doubts or inquiries, either orally or in writing (Resurreccion and Adanza, 2015).

Spiral Progression in the Philippines

This research looks at how science subjects are taught in the Philippines utilizing a spiral development technique. Spiral development has a theoretical and philosophical basis, according to a review of literature, although there is little actual research in the field of science. Because this technique was just completely introduced in 2012, research in this field is scarce, if not non-existent, in the Philippines. Its goal is to

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see how capable science teachers are at applying the way to teach science. Curriculum development is a dynamic state. Changes that are purposeful are referred to as development. Any modification, reform, or enhancement of current situation is referred to as a change for the better (Tinapay & Tirol, 2021). Improvement should be intentional, planned, and gradual in order to achieve favorable results. It will require years to determine whether or not the program is relevant to the demands of students and society (Tinapay & Tirol, 2021). In the Philippines, it is difficult to evaluate whether or not the spiral development method to science learning is important. It is necessary to assess this technique in order to identify whether, like in other nations, it will be phased out of the education systems after a set amount of time. The general education program in the Philippines is overburdened. As a result, President Benigno Aquino signed the Republic Act of 2013, popularly referred as the K to 12 Program, mandating that government schools use a spiral development strategy in their program.

The objectives of this research is to examine how the spiral development strategy can be used to teach science subjects in the Philippines. Although a literature review reveals theoretical and philosophical bases for spiral development, there has been few empirical research conducted in the field of science. Because this technique was only completely implemented in 2012, there is a paucity of research on this matter in the Philippines, if not an absence of research (Tinapay et al., 2021). Its step is to predict how capable instructors are in delivering science lessons utilizing the aforementioned approach. Curriculum design is a fluid procedure. Active members changes that are methodical in nature. In this context, "change for the better" refers to any revision, revisions, or improvements to a current state (Tinapay et al., 2023).

Development must be intentional, planned, and continuous if it is to result in positive transformation. It will take years to determine whether or not the program is efficient and receptive to the needs of learners and the public as a whole. In the Philippines, it is difficult to evaluate whether or not the spiral development method to science education is particularly beneficial. It is necessary to evaluate this technique in order to determine whether it will be eliminated from the academic system in the future, as has happened in other nations where this method has been eliminated from the schooling institutions after an amount of time. The basic education program in the Philippines is overburdened. The Republic Act of 2013 (also known as the K to 12 Program) was enacted by President Benigno Aquino as a result, requiring private and school systems to employ a spiral development strategy in their curriculums.

According to the findings of Resurreccion and Adanza (2015), in the Philippines, the spiral development strategy is a workable option to the education crisis as perceived by the Department of Education (DepEd). The findings of the study provide a perspective on the voice of science teachers in regard to the spiral progression strategy used in private and public secondary schools, respectively. They feel that it is extremely interesting to understand the ideas and opinions of instructors regarding the spiral development approach because instructors are the primary drivers of program development and implementation. In the absence of a thorough understanding of the program, instructors will be unable to apply it appropriately and efficiently in their classroom environments.

Science in Spiral Progression Approach

The work of Cabansag (2015 studying is more engaging, efficient, and pleasurable in the K to 12 grades, according to the findings, because students study Chemistry, Physics, Biology, and Earth Science all in the same year, and there're a variety of active learning that help them develop their abilities and capabilities. Furthermore, learners find the issues simple at first and increasingly more difficult, but they get a command of the subject because they are presented at their own rate and over a longer period (years rather than months). Cabansag's study is relevant to the current study since it focuses on the effect claim of multiple universities on the but forward in the K to 12 scientific program, which is the topic of the present investigation. The goal of the current study is to evaluate how well students are performing in the new science curriculum.

Additionally, Tan (2012) verified several reasons why spiral development was enforced, including the following: high pass rate, items in worldwide evaluation such as the Third International Mathematics and Science Study incorporate spiral-based queries, and science program frameworks in wide countries incorporate spiral-based questions.

According to certain studies on "Refocusing Spiral Curriculum" from the United States and Canada, a spiral curriculum must progress every year to avoid becoming circular. When paired with a learner-centered approach, the spiral program can become circular, with learners studying the same thing year after year. This occurs when a single learner is unable to comprehend or understand the same subjects. When pupils are confronted with a variety of topics, corrective assistance is difficult. Due to the spiral structure of the program, pupils are pushed into a variety of concepts without adequate time to learn each one.

In research titled "Student Perceptions of a Spiral Curriculum," Coelho (2015) found that while learners' opinions of the incorporated spiral curriculum are mostly favorable, there are difficulties to improve the learners' experiences. The spiral curriculum allows students to review and solidify their information, which is clearly beneficial to them.

According to the K to 12 Curriculum Guide Science (2013), the objective of the science curriculum is to produce systematically well-educated individuals who are active and informed respondents in society, responsible decision-makers, and use scientific understanding that will have a significant impact on the people and the setting. The science program is meant to help students progress their scientific procedures and abilities, as well as their comprehension and application of scientific information, and their development of scientific behaviors and beliefs.

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.

III. CONCLUSION

The above literature enhances the necessity and significance of conducting this study. The literature reveals the importance of the level of enactment of the Spiral Development approach in the new curriculum. While it is generally recognized that the educator's function is to assist rather than to teach material through rote learning, it is also true that the teacher's role is to support the learning process. If teachers offer students the knowledge they need through conversation but do not organize it for them, the spiral progression technique can assist the process of discovery learning. It emphasizes that teachers are the most essential and key drivers of the new curriculum, and their perspectives on the approach are crucial.

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