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Challenges and practices in implementing the Spiral Progression Approach in Science

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ABSTRACT: This study investigated the implementation of spiral progression approach in selected schools in Zambales. It employed qualitative method and conducted interviews to gather information about how spiral progression is applied in science classrooms, the challenges teachers face and the types of support they received. Findings reveal that teachers utilized technology-assisted, learner-centered strategies and incorporated responsive teaching practices such as remedial and enrichment resources to address students' varying levels of readiness. The participants reported that the challenges faced are difficulties in teaching complex concepts, time constraints and limited content knowledge in specific Science field. Despite these challenges, teachers received various support such as motivation from school leaders, mentoring sessions and access to learning resources. To further enhance the effectiveness of using this approach , study recommends continuous professional development training focused on enhancing content knowledge of teachers and on equipping them with effective strategies for review and enrichment.

KEYWORDS: K-12 Curriculum, Spiral progression, Science, Matatag curriculum

I. INTRODUCTION

Spiral progression approach has been introduced to Philippine Educational system when Republic Act 10533 of the Philippines, known as "Act Enhancing the Philippine Basic Education System" was implemented. Aside from adding two years to basic education and reiteration of universal kindergarten it also prescribes that the curriculum shall use the spiral progression approach to ensure mastery of knowledge and skills after each level (Official Gazette, 2013). Spiral progression approach in curriculum is derived from Bruner's Spiral curriculum model (Dunton and Co, 2019). Bruner stressed that teaching should lead to cognitive development and the role of spiral progression is to expose students to wide range of subjects and concepts so they can study them again while increasing the level of complexity until they have mastered them. This previous curriculum review was seen as a solution to the poor performance of Filipino students in international assessments. During the Programme for International Student Assessment (PISA) 2018, it is reported that in Science 78% of Filipino learners are below level 2 (World Bank Group Education, 2020). However, after 10 years of K-12 curriculum implementation, in the recent 2022 PISA result, the Philippines' average 2022 results were the same as in 2018 in mathematics , reading and Science. According to the report 23% of Filipino learners attained level 2 or higher in Science. (OECD, 2023) . These learners can recognize correct explanation for familiar scientific phenomena and can use such knowledge to identify, in simple cases whether a conclusion is valid based on the data provided. No Filipino learners reached Level 5 or 6, where students can creatively and autonomously apply their knowledge of and about science to a wide variety of situations , including unfamiliar ones. Therefore, the Philippine education system did not realize its aim to improve the performance of students through the introduction of Spiral Progression approach. The pandemic situation might have exacerbated the poor performance of Filipino learners. In addition, there might be problems in the implementation of spiral progression approach. There are limited literatures which have investigated the implementation of Spiral progression approach after the pandemic era. This study aims to address the gap on further investigation of the challenges of teachers in the implementation of Spiral progression approach.

II. LITERATURE REVIEW

Spiral Progression approach in Science Education

In response to the consistently poor performance of Filipino learners in national and international assessments, the Philippine government enacted Republic Act No. 10533, also known as the Enhanced Basic Education Act of 2013. This law introduced K-12 curriculum which institutionalized kindergarten and added two years to basic education (Orbe, Espinosa, Datukan, 2018). Center to this reform was a shift towards learner-centered strategies such as inquiry based learning, where students construct knowledge through the use of prior knowledge and hands-on activities. Stated in the Enhanced Basic Education Act of 2013, Rule 2 Curriculum, section 10.2.9. Standards and Principles, “The curriculum shall use the spiral progression approach to ensure mastery of knowledge and skills after each level. It also states that the overall design of Grade 1 to 10 curriculum follows spiral approach across subjects by building on the same concepts developed in increasing complexity and sophistication starting from grade school. In this curriculum, both vertical articulation and horizontal articulation of competencies are present. Vertical articulation aims to connect one lesson to the next across the program of study. While horizontal articulation integrates skills and knowledge across different disciplines (de Ramos-Samala, 2018). During the introduction of K-12 Curriculum. In K-1 2 curriculum Science subject underwent major revisions in terms of arrangement of competencies and learning contents. The previous curriculum followed a discipline-based model -Integrated Science was taught in 1st year High school, Biology in 2nd year, Chemistry in 3rd year and Physics in fourth year. In the K-12 curriculum Earth Science, Biology, Chemistry and Physics topics are spirally arranged into four year from grade 7 to grade 10. One quarter per grade level is assigned in each of the Science disciplines. The K-12 Science curriculum in the Philippines adopts a spiral progression approach, a learning strategy where students revisit same topics across different grade levels with increasing complexity and reinforcement of prior knowledge. (Antipolo and Rogayan, 2021). Spiral progression approach was introduced to address issues such as topic overlap, incoherence between educational levels and lack of content continuity. It also promotes learner-centered strategies, formative assessment, flexible content sequencing and helps in addressing students’ misconceptions (Perez, Bongcales, and Bellen, 2020).

The spiral approach introduced scientific content in simple terms during earlier grades, then gradually deepens students’ understanding as they progress through the curriculum (Alvarado, 2023). For instance, a fundamental concept on force is introduced in grade 7, and revisited with more complexity in subsequent years. Same applies with other Science specializations such as Chemistry and Biology. However, this process requires both teachers and students to continually review foundational concepts in order to effectively engage with more advanced topics. more advanced concepts related to force are discussed in the latter years. This iterative reinforcement, is expected to aid in the attainment of breadth and depth of understanding among Science learners (Tirol, 2022).

Spiral progression approach is supported by varied learning theories and educational philosophies. It is grounded in Jerome Bruner’s constructivism. Bruner emphasized active learning, where learners construct their own knowledge using their current or prior knowledge (Perez, Bongcales, and Bellen, 2020). Moreover, Jean Piaget’s cognitive development theory underpins the spiral curriculum model through principles of acquiring knowledge through assimilation and accommodation. The approach also aligns with progressivism. Progressivism involves discovery-based , inquiry based and problem-solving learning methods, where the teachers are expected to facilitate students’ learning. Within this learner-centered framework, teachers act as facilitators rather than mere transmitters of knowledge. K-12 curriculum also encourages the use of authentic assessment to evaluate learners’ acquisition of knowledge and skills. These authentic assessments can be done through project-base learning, performance tasks, portfolios and collaborative works and online tests.

Implementation of Spiral Progression approach in Science Classrooms

There are studies which investigated how spiral progression approach was implemented in the classrooms. Learner-centered teaching strategies were found to be effective in spiral progression. de Ramos-Samala (2018) found out that the use of cooperative learning along with the use of multimedia in class aided the students to develop their concept attainment and critical thinking skills. Moreover, discovery approach has been an effective strategy in Science, where students through laboratory experiments discover Science concepts and teachers facilitate in the learning process. Teachers and students also had to revisit basic concepts learned from previous years before they proceed to the discussion of more advanced lessons. However, this is considered as one of the challenge sduring the implementation. Students had a hard time remembering all the pre-requisite knowledge, compromising the time allotted for teaching more advanced concepts. (use of laboratory/hands on experience)

Challenges in the implementation of Spiral progression

Despite the theoretical strengths of spiral progression approach, its implementation has encountered several challenges, particularly among teachers. Igcasama (2021) found out that the shift had greatly influenced the curriculum particularly the content and transitions of subjects. Based on the findings, teachers are still struggling to adapt to the new curriculum. They needed more time and training to master all the fields and learn new teaching strategies. A major concern was the need for educators to teach outside their subject specialization, which required mastery across multiple disciplines Biology, Chemistry, Physics, and Earth Science rather than just one. Prior to the implementation of the K-12 curriculum, Science subjects in secondary education were taught in a discipline-based sequence: Integrated Science in the first year, Biology in the second, Chemistry in the third and Physics in the fourth. Under the spiral progression approach, however, students are exposed to key concepts from Biology, Chemistry, Physics and Earth Science at every grade level. During early stages of implementation, teachers were having hard time to adopt to the new approach , particularly those with specialization in specific disciplines such as Biology, Chemistry or Physics. Many perceived that lessons in earlier grade levels served as prerequisites for current topics, leading to difficulties in maintaining instructional coherence and flow (Valin and Janer, 2019). From a curricular perspective, horizontal articulation involves presenting concepts and skills from various Science disciplines in increasing levels of complexity. Meanwhile, vertical articulation, fosters deeper understanding of Science concepts by building on prior knowledge over time (de Ramos-Samala, 2018). Therefore, several studies emphasized the urgent need for ongoing professional development and support for teachers (Resurrection and Adanza (2015).

De Leon (2019) further identified key implementation challenges including insufficient teaching and learning materials, inadequate infrastructure, time restrictions, lack of training among teachers, overcrowded classrooms, lack of support from the government and lack of mastery on the subject matter. Similarly, Dunton (2018) cited poor implementation in terms of technical support such as monitoring, mentoring and motivating. In addition to content-related gaps, teachers also reported a high shortage of textbooks and supplementary materials which hindered student learning. There were also moderate shortage of science laboratories, laboratory apparatus and equipment, instructional equipment and other facilities. Additional issues affecting implementation included gaps in teachers' content, pedagogy and assessment strategies in chemistry as well as broader concerns related to instructional practices, teacher competence, in service training sufficiency, job satisfaction, support from upper management, laboratory adequacy, school resources, assessment tools and negative attitude of teachers toward Spiral Progression approach (Tapanan, 2021; De Leon, 2019; Gonzales, 2019; Dunton, 2018)

Students were also affected by the shift. Other studies corroborated that students had difficulty understanding and retaining science concepts under this approach, often needing to review foundational topics before progressing to more advanced lessons (Cabansag, 2014; Montebon, 2014; de Ramos-Samala, 2018).

Support Mechanism for Implementation

Despite the challenges, support systems have been identified to contribute to successful implementatio. Dunton (2018) found out that Science teachers received sufficient and appropriate mentoring and technical assistance through School learning action Cell. These collaborative structures offer opportunities for continuous professional development and peer learning, which are essential for building teacher capacity and sustaining effective teaching practices under the spiral progression approach. Available learning materials and laboratory equipment and models helped learners to grasp scientific contents although there shortage of equipment is reported.

Research Questions/Objectives

1. How is spiral progression approach implemented in Science classrooms?
2. What are the challenges encountered by teachers in the implementation of Spiral progression approach?
3. What are the supports received by the teachers in the implementation of Spiral Progression approach?

Participants

Participants of the study were 15 Science teachers coming from three secondary schools in Candelaria District, Schools Division of Zambales. These teachers have been teaching Science for at least 6 years.

III. METHODOLOGY

The study used qualitative study design allowing analysis of the implementation of Spiral progressive approach in Science subject. The design allows for the contextual exploration of the implementation of Spiral progression approach in terms of its translation to Science classrooms, the challenges faced by teachers and the scaffolds and support received by teachers. A 5 item interview guide was developed to discuss the practices, challenges and scaffolds during the implementation of the spiral progression approach. Content validity was ensured through expert validation and piloting to a few participants to align the questions with research questions. The researchers sought permit to the division head and administrators of selected schools in the province of Zambales. There were 15 Science teachers who met the inclusion criteria and agreed to participate in the study. The inclusion criteria required that participation be voluntary and that the participant is currently teaching in the K-12 Curriculum as Science teacher. The researchers conducted face to face interview with the teachers. Interview were transcribed verbatim and transcriptions were analyzed to describe the implementation of the spiral progression approach. Braun and Clarke's thematic analysis was utilized in the study which followed these steps: a) organizing and preparing of the data analysis, b) reading and looking at the data, c) coding, generating a description of the themes ; d) advancing how the description and themes will be presented and e) making interpretation of the findings or results.

Findings and Discussion

This study explored the different practices of teachers in implementing Spiral progression approach. In addition, it investigated challenges and support given to teacher during its implementation. The K-12 and Matatag Curriculum utilize learner-centered approaches such as inquiry-based learning pedagogy. This study investigated how the teachers implement spiral progression approach in the classroom. Participants of the study utilized learner-centered approaches such as inquiry-based learning.

Table 1. Implementation, challenges and support during the implementation of Spiral Progression approach

Sample Verbatim responses	Subthemes	Themes	Description
I think we can all agree that ICT integration ranks first, considering how frequently students utilize their devices and the more hands-on activities (P01)	Learner-centered strategies with ICT integration	Implementation of Spiral progression approach	This theme shows how teachers implement spiral progression inside Science classroom. It involves the strategies incorporated in their classes.
The Inquiry approach is one that I would suggest. It encourages students to investigate real world scenarios.			
More hands-on activities would be better as students are very engaged with technology, if necessary learning by doing.			
I think most teachers will likely provide enrichment and remedial sessions. I developed a SIM as my own slow learner intervention.	Responsive teaching via Remedial and Enrichment resources		
Time is crucial for learning in whatever we do. In my observation, and personal experience, there are some topics that I am unable to cover due to volume of competencies	Missed competencies		
Based on results of MPS for the school year, the challenging ideas I have covered were basic features and importance of photosynthesis and respiration…(P01)	Difficult concepts	Problems encountered in the implementation of Spiral progression approach	This theme pertains to the problems or challenges encountered by the teachers in Science classroom which incorporates spiral progression approach.
Based on the results of MPS, the challenging ideas I have covered were: Infer the relationship between current and voltage…(P05)			
Good in simple concepts, but there are some students who struggle with basic topics,	Time allotment for each topic		

complex ones are given longer time frames than simple ones. (P01)			
For example, in Biology , I can only offer what I know rather than a teacher who is a true expert in the field, thus my ability to provide a range of content may suffer.	Limited knowledge about the topic		
Absolutely, the amount of instruction will be affected because I can only provide a limited amount of knowledge (P10)			
Like me, Science is not my major although I love the subject and allocate more time to study before I deliver it might restrict the information that I can give to my learners (P06)			
Our supervisors constantly motivate us to continue working the way we are working. Mentoring takes place as time and need permit (P08)	Motivation from Supervisors	Support to teachers in the Implementation of Spiral Progression Approach	Despite the challenges, teachers receive support from administration. This theme discusses different supports or scaffolds given to the teachers.
My superiors regularly offer words of support to us as a method to keep us motivated. When necessary, mentoring takes place. Once every three months, I am checked on (P11)			
If necessary , we conducted focus group discussion at our Science department. This gives us the opportunity to discuss the difficulties and methods we are using when teaching the subject (P03)	Mentoring		
We occasionally have FGDs, but when we do, it is usually when there are significant issues that need to be discussed. I find this kind of discussion to be really beneficial because it gives us the chance to address our struggles with the various things			

we study (P13)			
We are fortunate that our school has a laboratory in the Senior High School department, that Junior High school students dan use when necessary. We also have many equipment, the majority of which are in good working condition (P12)	Availability of resources		
Of course, there are TVs and projectors available and when necessary lab equipment is employed (P04)			

In inquiry-based, students construct their own understanding by building on prior knowledge and experiences. Teachers also found it effective to integrate technology into students' hands-on activities. Integrating technology can make instruction more engaging and enjoyable, especially when addressing complex concepts. It also enables learners to access information related to the topics they are studying. However, the benefits of educational technology are maximized only when used strategically. It is essential to guide students in validating the accuracy of online information, as not all sources are credible.

The spiral progression approach requires students to master fundamental concepts before progressing to more complex topics. However, because the students are heterogeneously grouped, their learning capacities vary. Some students need more time to review basic concepts in order to understand advance concepts, while other struggle to grasp the content within allotted time frame. To address this, teachers employed responsive teaching through the use of remedial and enrichment material. Having these resources prepared in advance contributes significantly to the successful implementation of the spiral curriculum. Since review sessions may be time consuming during regular class hours, providing review materials ahead of time allows students to prepare independently. This enables teachers to dedicate only a brief portion of class tome to review rather than reteaching foundational concepts. In the implementation of the spiral progression approach, it is inevitable that some competencies may be missed. Although curriculum decongestion is one of the key issues addressed by the K-12 and, teachers still face challenges in covering all the topics outlined in the curriculum guide. One contributing factor is the time required to reteach fundamental concepts before progressing to more complex ones. It is difficult for teachers to introduced advanced topics when students have not yet mastered the fundamental concepts. Therefore, it remains essential to review and evaluate the learning competencies included in the current curriculum.

There were also challenges identified in the implementation of spiral progression approach. The challenges are complex concepts included in the curriculum, insufficient time allotment for each topic, and limited knowledge of teachers about the topic. During the implementation of the Spiral progression approach, the teachers in the field were trained in their respective specializations. However, upon the implementation of the new curriculum, they were required to teach a variety of science subjects including Earth Science, Biology, Chemistry and Physics. Many teachers found some of the topics difficult to teach, especially those outside their field of expertise. This misalignment created challenges, as they had limited training in specific science concepts beyond their specialization. One of the main challenges identified in the implementation of the Spiral curriculum is the lack of adequate in-service training (Orbe, Espinosa, Datukan, 2018). For instance, a Physics major may find topics on electricity manageable, while a Biology major may struggle with teaching electricity and magnetism. The teachers reported having limited knowledge in Science areas unrelated to their specialization, which negatively affected their confidence and effectiveness in delivering lessons. This issue of teaching outside one's area of specialization was also highlighted by Resurrection and Adanze (2015). Although teachers made extra efforts to prepare for the discussion, this was often insufficient for them to feel fully confident when teaching unfamiliar content. Therefore, in depth training in Science concepts is highly recommended. Although the problem on in-service training has been addressed by offering Secondary education programs majoring in General Science, many teachers in the field are still specialized only in Chemistry, Biology, Physical Science or Biological Sciences. Continuous professional support and content enrichment from experts in the field remain essential. These teachers may be pedagogically equipped , but they often lack content mastery – a critical factor in effectively teaching specialized science subjects. These findings were aligned with that of Radcliff (2020), Miao (2020) and Villanueva (2021) who also found out that one of the challenges in the implementation of Spiral progression approach is the lack of professional development opportunities for teachers. Other issues include the need for extensive curriculum planning, inadequate instructional materials and difficulties in assessing students' learning. In addition to content mastery, time allotment for teaching science subjects was also a concern. Participants reported that while time may be sufficient for covering basic concepts, many students still struggle to grasp these foundational ideas. This makes transition to more complex topics even more challenging. This concern is in line with the findings of Tirol (2022), who noted that spiral progression may put students requiring remedial classes to disadvantage. Without mastering or recalling fundamental concepts, they may find it difficult to understand more advanced lessons that build foundation lessons. In spiral progression approach, students revisit concepts across grade levels, thus students may forget prerequisite lessons discussed a year or two earlier. As a result, teachers often need to allocate time for reviewing prior knowledge before introducing more advanced topics. Thus, it is essential for teachers to identify effective review strategies that reinforce prerequisite concepts without sacrificing time intended for new lesson. Unfortunately, this challenge is often overlooked in both in -service and pre-service training programs, which tend to focus more on science content than on pedagogical strategies for review and transition. Therefore, additional trainings in pedagogy especially in adopting effective review strategies and in managing transitions between topics is recommended. Adopting more learner centered approach will be beneficial to both teachers and students. The Spiral progression approach in Philippine education also emphasizes learner-centered, iterative revisiting of concepts, increasing complexity and integration of science content with process skills, fostering engagement and scientific literacy through active, hands-on learning experiences from grades K to 12 (Tirol, 2022). Even with the introduction of the *Matatag* Curriculum, Science remains dense with competencies that must be reviewed to ensure that time allocations are sufficient for each topic. During the implementation of the K12 curriculum, there are in service teachers who are Science majors but with different specializations. For example, some Biology majors only had Physical Sciences as minor subjects, while Chemistry and Physics majors may have ad limited exposure to Biological Sciences. Compounding the problem, some science teachers in the field were not Science majors at all. Spiral progression approach covers Science across different specializations within the year, therefore the teacher should be knowledgeable in the topics such as Earth science, Biology, Physics and Chemistry. While teachers education programs have begun to prioritize General Science as a major, many in service still lack expertice in certain science subjects. These teachers need further scaffolding and continuous retooling in Science content. Therefore, ongoing professional development aimed at strengthening teachers' mastery of Science is strongly recommended.

This study also examined the support provided to teachers during the implementation of spiral progression approach. One significant source of support was the motivation and encouragement from supervisors. Supervisors played crucial role in uplifting teachers' morale, especially when they were assigned to teach outside their areas of specialization. Words of encouragement had a substantial impact on teachers' willingness to go the extra mile in lesson preparation and delivery. In addition to moral support, mentoring sessions and focus group discussions provided platforms for teachers to express concerns and resolve instructional issues collaboratively. Interestingly, most participants did not have concerns about access to instructional resources. According to them they have laboratory equipment which they can use for hands-on experiments. Aside from the laboratory equipment, and other teaching aids were available and used effectively during lectures and hands-on experiments. Moreover, teachers recognized that incorporation of learner-centered pedagogies has been a valuable approach during the implementation of Spiral progression approach, aiding both student learning and teacher instruction.

IV. IMPLICATIONS

Spiral progression approach continuous to pose challenges for teachers in translating the curriculum into effective Science classroom instruction. To address these challenges, a continuous review of the curriculum is recommended, particularly with regard to the time allotted for teaching complex topics. Despite efforts at curriculum degongestion under both the K-12 and Matatag curricula, teachers are still faced with a substantial amount of Science content to cover within a limited time frame. As a result, they often prioritize covering all listed topics over ensuring students develop mastery of fundamental concepts. This creates a domino effect-students who have not mastered the basics require both reteaching and review before they can engage with more advanced content. To minimize the time spent on review, teachers must be equipped with effective strategies such as the development of targeted review materials, the integration of technology and the use of blended learning approaches. While problem on in service training has been addressed, this study highlights the need for continuous professional development focused on deepening content knowledge. University with faculty who specialize in specific Science fields can play a key role in delivering such professional development programs for in-service teachers. Although learning resource availability is generally not seen as a major issue, teachers could benefit from further training on the effective use of laboratory equipment and technology to support learner-centered strategies. Simply having access to these resources is not enough; without a shift from traditional methods, the potential benefits of the spiral progression approach may not be fully realized.

V. CONCLUSION

This study contributes to the limited body of literature on the implementation of the spiral progression approach in the post-pandemic era and following the introduction of the Matatag curriculum. It explored how this approach is applied in Science classrooms, the challenge teachers face and the types of support they receive. Findings reveal that teachers utilized technology-assisted, learner-centered strategies and incorporated responsive teaching practices such as remedial and enrichment resources to address students' varying levels of readiness and manage limited instructional time. Despite efforts at curriculum decongestion, the Science curriculum remains densely packed, often forcing teachers to omit certain learning competencies. Many in-service teachers, who often specialize in a specific Science field, reported difficulties in teaching complex concepts due to limited content knowledge in specific areas. Time constraints also hinder the comprehensive coverage of the curriculum.

Nonetheless, teachers received various forms of support, including motivation from school leaders, mentoring sessions and access to learning resources. To further enhance instructional effectiveness, the study recommends sustained professional development programs focused on strengthening teachers' content knowledge and equipping them with effective strategies for student review and enrichment. This study is limited to selected schools in a specific province. Future research with broader geographic coverage and integration of quantitative methods is recommended to generate more generalizable findings. Additionally, as assessment practices did not emerge as a prominent theme in the study, further research focusing on assessment strategies within the spiral progression approach is warranted.

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4. Declaration of Generative AI in Scientific Writing

During the preparation of this work , the authors used ChatGPT to enhance the cohesiveness of the manuscript. After using the tool, authors reviewed and edited the content as needed to retain its intended meaning. Authors take full responsibility for this publication's content.

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