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Research Article

TEACHERS' PERCEPTIONS, EXPERIENCES, AND SUGGESTIONS TOWARD SPIRAL PROGRESSION OF CHEMISTRY CONTENTS

***Gemzonrey H. Nahine, May Ann Nuñez, Alfons Jhon L. Cabrezos, Alvin S. Solomon, Malyn A. Bete, Recca C. Macalib-og and Maris Jade Q. Orongan**

Science Education Department, Central Mindanao University, Philippines

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Abstract

This study investigated the teachers' perceptions, experiences, and suggestions toward the spiral progression of chemistry contents in Junior High School. The respondents were four science teachers at Don Carlos National High School. The data were analyzed through thematic analysis. It was found that Content and knowledge and Allotment are the themes revealed from teachers' perceptions. Conceptual understanding, Variations, Expertise, and Time for the teachers' experiences. Lastly, Specialization, Simplification, and Planning were the themes revealed for the teachers' suggestions on implementing the spiral progression approach. Therefore, it was recommended that it would be highly beneficial to investigate the experiences of present science teachers in other larger districts within the division of Bukidnon, or even in other areas of the Philippines, and curriculum planners should give science teachers with sufficient information to address the spiral progression in a more effective way.

Keywords: ICT, Technological Skills, Learning.

INTRODUCTION

The Philippines' Department of Education (DepEd) is working to offer outstanding, equitable, and accessible education as required by Republic Act 9155, Governance of Basic Education Act of 2001 (Kelly *et al.,* 2020). Similarly, the Enhanced Basic Education Act of 2013 (RA 10533), or the K-12 program, aims to bring the Philippine education system up to worldwide standards. This 2013 Enhanced Basic Education Act means each graduate can think critically, independently, and creatively, has the capacity and willingness to transform oneself and others, has the competence to work and be productive, and has the potential to coexist in fruitful harmony with local and global communities. However, despite these aspirations, the quality of education in the Philippines has been declining in recent years. According to TIMSS 2019 and PISA 2018 reports, the Philippines ranked 249th and 78th in science subjects. Furthermore, according to Tirol (2021), SEI-DOST identified factors affecting the low performance of Filipino students; this includes teacher quality, the teaching and learning process, the school's curriculum, instructional materials, and administrative support. Given this, it is crucial to focus on the current situation of the science curriculum in improving the quality of science education in the country. The K-12 science curriculum has integrated Jerome Bruner's spiral progression-based curriculum paradigm. The spiral progression approach exposes students to a wide range of concepts/subjects and disciplines until they grasp the topic by studying it again with increasing complexity as they progress in the grade level (Braund, 2007, cited by Dunton & Wilhelmina, 2019). All four major science fields will be taught in one school year, separated into four grading periods. This technique reinforces previously taught material.

Corresponding Author:** ***Gemzonrey H. Nahine,
Science Education Department, Central Mindanao University, Philippines.

When the topic is brought up again, it can be gradually broadened, leading to a stronger understanding and transfer (Dunton and Wilhelmina, 2019). More importantly, since the Philippine educational system is adopting the spiral progression in teaching science subjects, content must be aligned to ensure continuity of learning. The spiral complexity of a content organization is now a widely used approach to effectively revisit and increase the subject's difficulty. Study shows in Bangladesh and Turkey that the spiral curriculum was partially sequenced (Bain & Siddique, 2017; Yumusak, 2016 & Gurbuzturk *et al.,* 2013). Similarly, in the study of Tirol (2021), it was determined that the current science curriculum in the Philippines is spirally sequenced in terms of Biology content. Although there is an amount of literature on the spiral progression approach and how it is used to organize and implement science curricula in regional neighbors, there are few empirical studies on how science material is contained in the Philippine educational setting. There is a need to study the curricular alignment of chemistry contents in Junior High School since these organization of topics can affect students learning and thus making sure the chemistry contents are spirally sequenced is very important. Hence, the researchers geared to assess the curricular alignment of sciences in junior high school, specifically in chemistry subject. Thus, this study will bring light to the stakeholders like teachers and students as well as the curriculum makers to see in detail how the spiral progression approach is implemented in the Philippine settings and identify strengths and weaknesses to be improved in strengthening the current approach.

Objectives of the Study

This study aimed to investigate the teachers' perceptions, experiences and suggestions in the implementation of spiral progression approach specifically in Chemistry contents in Junior High School.

MATERIALS AND METHODS

Research Design

This study is qualitative research using a thematic analysis research design to determine themes on teacher's perceptions, experiences and suggestions in the implementation of spiral progression approach especially in the chemistry contents.

Participants of the Study

A purposive sampling technique was employed in the study. One teacher per grade level, a total of four (4) science teachers of Don Carlos National High School, were the participants of this study who are currently teaching science in the school year 2022-2023. The criteria for choosing the participants were based on number of years teaching science subjects in Junior High School under the implementation of spiral progression approach.

Data Analysis

The research utilized a thematic analysis in determining the existing themes that correspond to the teachers' perceptions, experiences and suggestions toward spiral progression of chemistry contents in Junior High School gathered from the teachers' responses during an interview. Moreover, in getting the teachers' perceptions, experiences and suggestions in the implementation of spiral progression approach, the following questions adapted and modified from the study of De Ramos-Samala (2017) were used.

1. What are your perceptions about articulating chemistry topics in a spiral progression approach?
2. What are your positive and negative experiences in the implementation of the spiral progression approach?
3. What are your suggestions to improve the implementation of the spiral progression approach?

LITERATURE REVIEW

The K-12 Curriculum

The K to 12 Curriculum consists of Kindergarten, Grades 1 through 12, and two years of Senior High School in the Philippines. In response to globalization, the Philippines modified the 10-year primary education into a K–12 curriculum (Adarlo & Jackson, 2017). The K-12 Curriculum provides a 12-year education for all children, regardless of socioeconomic condition. This new curriculum in the Philippines provides enough time to absorb concepts and abilities, build more profound knowledge, and promote higher-level learning. Proponents of the K-12 system say it will improve Philippine education and generate job-ready graduates. The new curriculum was implemented as a reaction to various problems in the country, but it also brought new worries because it changed the educational system, which affected Filipinos. Dizon *et al.* (2019) and Edna *et al.* (2018) found that the execution of K-12 programs faced the following challenges: a) lack of preparation and professional development; b) excessive academic burden on students; and c) integration of teachings in the real-life environment. It would be impossible for all teachers to enroll in training programs to handle changes and ensure their development meets societal needs. Relucio and Palaoag (2018) revealed that several K-12 curriculum stakeholders in the Philippines opposed implementation. The Philippines should modify its K–12 curricula by changing the rules. The goal of the K to 12 Curriculum is to have students develop 21st-century skills. In order to ensure that all students receive the best education possible, schools regularly assess student progress. Assessments are designed to measure student understanding of the material and skills taught in the classroom. In addition, the assessments determine whether students are making sufficient progress in each subject area. These assessments are standardized and aligned with the expectations of each grade level. The purpose of the assessments is to provide educators with data that can be used to improve instruction and inform decisions about student progress and achievement. However, there are still issues that still need to be addressed in the implementation of the reform curriculum. According to Rivera (2017) and Barrot (2018), there are inconsistencies between the existing learning pedagogies and the anticipated learning outcomes. This means there is a misalignment between the teachers' teaching methods in getting the expected student learning outcomes as K-12 is being implemented. This disconnect can result in several problems for students, such as a lack of critical thinking skills and an inability to adapt to changes. This must be addressed as soon as possible, particularly in Junior High School, before students can move to more comprehensive and complex strands in the Senior High School arena.

Spiral Progression

K-12 Basic education arrived in 2011. Rule 2. Curriculum, Section 10.2.g. Standards and Principles of Republic Act No. 10533, often known as the "Enhanced Basic Education Act of 2001", states: "The curriculum shall follow the spiral progression model to achieve mastery of information and skills after each level." The "Implementing Guidelines of Grades 1 to 10 to Enhanced Basic Education Curriculum," Attachment No. 1 to Department of Education (DepEd) Order No. 31, s. 2012, states that "the overall design of the Grades 1 to 10 curriculum follows the spiral approach across subjects by building on the same concepts developed with increasing complexity and sophistication beginning in elementary school." Teachers are supposed to teach competencies using the "spiral progression method." How the topics move in a spiral show how lessons are connected at each grade level (Samala, 2017). The study of Cabansag (2014) shows that teachers' knowledge of the program revolves more around the delivery of topics in a spiral progression and on grading systems based on level of proficiency. Some students disclosed that learning is more interesting, effective, and enjoyable in K–12 because they all learn Chemistry, Physics, Biology, and Earth Science in one year. Also, students find the topics easy at first, but they get more complex over time. However, they learn the topics well because they can go at their own pace and study them for a long time. On the contrary, some students did not agree that the K-12 program is more interesting, effective, and enjoyable because the topics are too complex, and they need to stay longer for two years in senior high school. The goal of the spiral progression strategy is to expose students to a wide range of ideas, topics, and fields of study until they have mastered the material by going over it repeatedly at more difficult levels. Sanchez (2017) stated that there are four areas of science in the high school science curriculum: integrated science, biology, chemistry, and physics. In the old curriculum,

the first year was about Integrated Science, the second year was about Biology, the third year was about Chemistry, and the fourth was about Physics. Still, the new high school science curriculum that started in 2012 teaches these four main ideas simultaneously. Students use a spiral development method where each grading period focuses on one of four subject areas. In addition, integrated science was renamed "Earth Science." Concerning this, De Dios (2012) says that high school science classes break into their fields. It required teachers with Martin (2008) says that a spiral curriculum is a design framework that helps science teachers make lessons, activities, and projects that focus on developing thinking skills and attitudes beyond identification. It requires growth and continuity in science education. Therefore, the spiral progression strategy is a method for implementing a spiral curriculum; this helps the learner to remember what he or she has already learned. As a result, a vast range and depth of information are attained. However, science teachers revealed their disappointment as spiral progression in the K-12 framework needs more concentrated and extensive, challenging instruction. In addition, the content standard allotted per year level needs to be revised and improved. Since the subject changes quarterly, the focus is minimal, lacks depth, and needs more concentration, which is not aligned with what spiral progression should be (Espinosa, 2018). According Snider (2004) cited by Resurreccion & Adanza (2015), the spiral progression strategy prevents discontinuities between phases of schooling, enables students to learn topics and skills suited to their developmental/cognitive stages, and improves retention and mastery of topics and abilities as they are reviewed and solidified. However, the problem with the spiral design is that the rate at which new concepts are introduced is frequently either too fast or too slow. Whether an idea is simple or complex, the same amount of time is allocated for mastery. Each topic within a unit consists of one day's worth of instruction. Sometimes, there will need to be more time for introductions. Because an entire class session must be committed to a single idea, it is not accessible to schedule education so that students gain prerequisite abilities before being introduced to a challenging ability. In a spiral curriculum, numerous topics are briefly presented. Kronthal, 2012 as cited in Resurreccion & Adanza (2015), shows that the spiral curriculum is an extreme example of combining the sciences. But De Dios (2013) says that the spiral curriculum can only spend a quarter of a year on each branch. This means that students will only learn about a few topics in each science field each year. The biggest problem with a spiral curriculum is that it can't cover many different topics in one area in one school year. It is inherent to the subject matter.

Curriculum Alignment

Curriculum alignment is the process in which educators formally evaluate a course or an educational program to address the changing needs of students and the workforce. An aligned curriculum refers to an academic program that is well organized and purposefully designed to facilitate learning, free of academic gaps and needless repetitions, and aligned across lessons, courses, subject areas, and grade levels (Glossary of Education Reform, 2014). Similarly, alignment is an agreement or match between two categories, such as state standards matching the content of a district curriculum. For example, if the state standards reference "number concepts" and the curriculum covers "number concepts," there is alignment between the standards and the curriculum. The categories match. Of course, the substance contained by number concepts in both cases must match (Squires, 2013). The study of Rivera (2018) and Perez (2020) concluded that in implementing the K to 12 curricula, the basis of the approaches in the learning process must be inclined to learner-centeredness. Discovery approach/ inquiry learning, collaborative/ cooperative learning, and experiential learning as the teaching strategies employed in the context of the spiral curriculum. It was found that the teachers practicing learner-centered approaches are effective in teaching. However, teachers have many criticisms towards the spiral curriculum, such as repetition of contents across grade levels, untraceable articulation of competencies, limited topic organization, lack of depth and concentration for each area in science, and the omission of some fundamental concepts, challenges in their content expertise and provision of resources. It was recommended that the teachers must be flexible enough to localize, indigenize, and contextualize the content of the curriculum to what is best suited for the students for the betterment of learning. Spiral growth produces disappointing results when barriers aren't addressed during design and implementation. Flaws in the technique include insufficient review time, limited academic learning time, shallow learning, and incorrect topic introduction rate. The study highlighted the teacher's importance in curriculum implementation. Teachers need extensive content and pedagogical understanding to promote curriculum effectiveness. More importantly, in the study of Yu *et al.* (2022), it was found that in China, the curriculum standards and textbooks are not aligned; textbooks are highly consistent and statistically significant but independent of curriculum standards; the distribution of curriculum standards and textbooks across various core concepts and cognitive levels is unbalanced; and both curriculum standards and textbooks overemphasize the cognitive levels of remembering and understanding, while minimally representing the cognitive levels of reasoning and problem-solving. On the contrary, Tirol (2021) found that biology content was spirally sequenced and implemented in the Philippines.

RESULTS AND DISCUSSION

Table 1. Teachers' Perception on the articulation of chemistry topics in a spiral progression approach?

Theme	Sub-themes
Content and knowledge	Articulation
	Learning process
Allotment	Needs more time

In this table, the theme Content and knowledge refers to articulation and learning process and Allotment means needs more time.

1. Content and knowledge

a. Articulation

"The concepts in chemistry are well divided within the four grade levels, from Grade 7 to Grade 10."

Respondents attested that the subjects presented are well-structured and balanced across all grade levels, with increasing complexity. Cabansag (2014) stated that students enjoyed learning in the K-12 program since they learned all four

subjects in one year with increasing difficulty. However, according to Orbe *et al.* (2018), chemistry contents are not spirally sequenced.

b. Learning process

"The spiral progression helps learners learn the fundamental facts of the subject, exposes them to a wide range of concepts and helps them learn continuously."

" It exposes learners to a wide variety of concepts until they master them by studying them."

"It also encourages the retention of skills from the previous year as well as the continuous review of concepts."

Respondents corroborated that a spiral progression approach enables students to master the material by exposing them to various concepts and teaching them the fundamentals. According to Snider (2004) cited by Resurreccion & Adanza (2015), the spiral progression technique minimizes discontinuities between periods of schooling, allows students to learn topics and skills suitable to their developmental/cognitive stages, and enhances retention and mastery when topics and skills are reviewed and solidified. However, according to Rivera (2017) and Barrot (2018), there are inconsistencies between present learning pedagogies and intended learning results, which indicates teachers' teaching methods are not aligned with K-12's expected student learning outcomes.

2. Allotment

a. Needs more time

My own perceptions regarding the articulation of chemistry topics are that they need ample time to be learned and studied. According to the respondents' transcript, learning the chemistry in spiral progression approach needs ample time in terns if studying the contents. This testimony coincides with the study of Resurreccion &Adanza (2015) that spiral progression design has the disadvantage of introducing new concepts at either too fast or too slow. Regardless of how easy or difficult a topic is to grasp; it is assigned the same amount of time.

Table 2. Teachers' positive and negative experiences on the implementation of the spiral progression approach

Theme	Sub-themes
Conceptual understanding	Retention and mastery of concepts (+)
Variations	Wider avenue for learning (+)
Expertise	Teacher lacks mastery (-)
Time	Perturbations (-)
	Overemphasis on reviewing (-)

In this table, themes were divided into positive and negative experiences of the teachers. The theme conceptual understanding refers to retention and mastery of concepts; variations refer to wider avenue for learning entails the positive experiences of the teachers while, expertise refers to teacher lacks mastery; and time refers to perturbations and overemphasis on reviewing shows the negative experiences of the teachers.

1. Conceptual understanding

a. Retention and mastery of concepts

"First, it helps students retain skills for later grades in the positive sense. It is easy for them to recall the previous lessons that could be used in the new lessons."

"Ensures that the learners master the important concepts through revisits or reviews from their previous lessons before introducing a more complicated lesson."

"As a bioscience teacher who is also studying chemistry and physics, I have learned a lot. We teachers must be equipped, especially in terms of changes in the curriculum."

The spiral progression method aids students in retaining and mastering the concepts and competencies as well as gaining more comprehension of the subjects. Reviewing and revisiting concepts that could be used to introduce new courses makes it simple for them to recall previously discussed topics. This is congruent to the study of Snider (2004) cited by Resurreccion &Adanza (2015)that spiral progression enhances retention and mastery. Moreover, Martin (2008) says that a spiral curriculum is a design framework that helps science teachers to develop the thinking skills and attitudes required for growth and continuity in science education.

2. Variations

a. Wider avenue for learning

"The learners are also exposed in different areas which allow them to discover their interest, their strengths, and weaknesses in science."

SPA provides an opportunity for students to find their areas of interest by introducing them to a variety of subject matter. According to Cabansag (2014), they learn the topics well because they can go at their own pace and study them for a long time. Also, Dunton & Wilhelmina (2019) stated that the goal of spiral progression approach is to expose students to a wide range of concepts/topics and disciplines until they master them by studying them repeatedly but with varying degrees of complexity.

3. Expertise

a. Teacher lacks mastery

"Teachers, particularly those with different majors, are unable to simplify and expound concepts due to a lack of subject mastery."

Respondents attested that teachers lacked experience in subjects outside of their field of expertise and desired to educate only within their field. Further, Snider (2004) cited by Resurreccion & Adanza (2015) stated that teachers need extensive content and pedagogical understanding to promote curriculum effectiveness. More importantly, they added that science teachers were still adjusting to the new curriculum; they required additional time and training to master all of the subjects and learn new teaching methodologies because it is difficult to teach anything in which one lacks mastery.

4. Time

a. Perturbations

"In November, when we had our SDS visit, there was a class interruption. We are left with few opportunities to discuss the main topics."

Due to school events and interruptions, there was insufficient time to study the curriculum content, and they were unable to satisfy all DepEd-mandated learning competencies. According to Kraft *et al.* (2021), it is also evident in U.S. public schools regarding class interruptions due to intercom announcements and visiting of staff and administrators at school. It was also stated that tardiness resulted in interruptions in classes which prompted teachers to review the topics again.

b. Overemphasis on reviewing

"There is an overemphasis on reviewing the previous topics."

"We missed some of the competencies that we need to meet in discussing the topic because we spent the first few weeks of the class revisiting the previous concepts learned by the students."

The curriculum-mandated competencies were not completely realized because teachers used the time that was supposed to be spent on new topics to review and revisit the preceding lesson. Rivera (2018) and Perez (2020) stated that barriers aren't addressed during design and implementation, and spiral growth produces disappointing results. Flaws in the technique include insufficient review time, limited academic learning time, shallow learning, and incorrect topic introduction rate. Moreso, the most significant disadvantage of a spiral curriculum is its inability to cover various topics within a single area in a single academic year (De Dios, 2013).

Table 3. Teachers' suggestions to improve the implementation of the spiral progression approach

Theme	Sub-themes
Specialization	Alignment to teachers' specialization
Simplification	Simplified contents
Planning	Curriculum Planning

In this table, the theme specialization means alignment to teachers' specialization; simplification means simplified and expounded contents; and for planning it means curriculum planning.

1. Specialization

a. Alignment to teachers' specialization

"I would suggest it be aligned in teaching assignments based on the teacher's major. For example, a biology teacher should teach biology, and a chemistry teacher should teach chemistry."

Respondents stated that a teacher's subject matter should be determined by their major. Teachers who do not know a subject well are not likely to have the knowledge they need to help students learn this content. Teachers' specialized subject knowledge is the biggest predictor of student progress; focusing on that instead of advanced content knowledge might be beneficial. To help students construct cognitive maps, relate ideas, and rectify mistakes, teachers must know their subject well and be flexible. Teachers must relate concepts across fields and to life since pedagogical content knowledge helps teachers communicate concepts (Ball, 2008).

2. Simplification

a. Simplified contents

"I think the lessons should be in a simpler form first, with more reviews and activities suitable for their thinking, and they need more time."

"Teachers are given learning modules that are more detailed rather than having modules that have narrow explanations and few examples of a certain topic to help students in their learning."

The respondent finds the learning materials difficult for the student's level of comprehension and so suggests that the topic be simplified and elaborated by offering more reviews and activities. According to Boston College (2019), The purpose of the science curriculum is to help students develop fundamental scientific concepts and information about the biological and physical components of the world, as well as the processes by which they acquire this knowledge and understanding.

3. Planning

a. Curriculum Planning

"Revisit the spiral progression and how to deal with it accordingly based on the levels of the students compared in the city and in the barrio in the far-flung area."

The respondent suggests revisiting curriculum development in order to properly implement SPA in various areas, particularly in barrio schools .A strong curriculum requires planning. This will act as a roadmap for curriculum implementation. A curriculum should be planned with several things in mind, including the learners, the support material, time, subject matter or content, the desired goals, and the context of the learners (Bilbao & Corpuz, 2014)

CONCLUSION

On the light of the findings of this study, the following conclusions were drawn; The teachers' views on the spiral progression of chemistry topics points to Content and knowledge (articulation and learning process) and Allocation (needs more time). As to positive and negative experiences with the implementation of the spiral progression approach, they observed that SPA has a positive impact on the following: Conceptual understanding (retention and mastery of concepts), Variatons (wider avenue for learning), and negative impacts on Expertise (lack of mastery by the teacher), and Time (Perturbations, Overemphasis on reviewing). In order to strengthen the implementation of the spiral progression approach, teachers emphasized Specialization (alignment with teachers' areas of expertise), Simplification (simplified contents), and Planning (Curriculum Planning).

Recommendations

Based on the results of the study, the following recommendations were made:

a. For a wider population, it would be highly beneficial to investigate the experiences of present science teachers in other larger districts within the division of Bukidnon, or even in other areas of the Philippines.
b. Curriculum planners should give science teachers with sufficient information to address the spiral progression in a more effective way.

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REFERENCES

Adarlo, G. and Jackson, L. (2017). "For whom is K-12 education: a critical look into twenty-first century educational policy and curriculum in the Philippines," in *Proceedings of the Educating for the 21st Century*. Springer, Singapore, 207–223.

Ball, D.L. (2008). Content Knowledge for Teaching: What Makes It Special? *Journal of Teacher Education,* pp.389-407

Barrot, J. (2018). "Exploring the implementation of communicative language teaching in the Philippines: a tertiary teachers' perspective," *Advanced Science Letters*, 24 (4), 2284–2287.

Boston College (2019). The Science Curriculum in Primary and Lower Secondary Grades. TIMMS & PIRLS Study Center. https://tinyurl.com/yc7ke7nu

Cabansag, M.G. (2014). Impact statements on the k-12 science program in the enhanced basic education curriculum in provincial schools. *Researchers World,* 5, 29.

De Dios, A. (2012). Philippines' Basic Education. Department of Health's Curriculum II. Discovery Learning Scaffolding. http://kadriyeportfolio77.weebly.com/...-1715.html

De Ramos-Samala, H. (2018). Spiral Progression Approach in Teaching Science: A Case Study. *KnE Social Sciences*, *3*(6), 555. https://doi.org/10.18502/kss.v3i6.2404

DepEd. (2016). *K to 12 curriculum guide*. *July* 247. http://www.deped.gov.ph/sites/default/files/page/2017/English CG!.pdf

Dizon, R. L., Calbi, J. S., Cuyos, J. S., Marilyn Miranda, M. (2019). Perspectives on the Implementation of the K to 12 Program in the Philippines: A Research Review.

Dunton, J. B., & Wilhelmina, S. (2019). "Spiral Progression Approach in Teaching Science and the Performance of Learners in District I, Capiz." *Journal of Physics: Conference Series*, *1254*(1). https://doi.org/10.1088/1742-6596/1254/1/012045

Edna, R., Gatchalian, V. M. P., Mamisao, J. C. B., Canuto, X. O., Caugiran, M. D., Ekid, J. C. A., Ilao, M. J. C. (2018). Problems and Challenges Encountered in the Implementation of the K To 12 Curriculum: A SYNTHESIS. School of Teacher Education and Liberal Arts, Saint Louise University. https://www.academia.edu/39704530/problems_and_challenges_encountered_in_the_implementation_of_ the_k_to_12_curriculum_a_synthesis

Education Curriculum in Provincial Schools. *Journal of Arts, Science & Commerce*, 29- 39.

Espinosa, A. A. (2018). Teaching Chemistry in a Spiral Progression Approach: Lessons from Science Teachers in the Philippines. *Australian Journal of Teacher Education*, 17-30.

Gurbuzturk, O., Gurleyuk, C.G. and Saylan, A. (2013). Investigation of "Matter and Change" through spiral currıculum model: Turkey Sample. *Procedia-Social and Behavioral Sciences,* 116 (2014) 4604-4611. DOI: https://www.sciencedirect.com/science/article/pii/S1877042814010 106 [22

Kelly, D.L., Centurino, V.A.S., Martin, M.O., & Mullis, I.V.S. (Eds.) (2020). TIMSS 2019 Encyclopedia: Education Policy and Curriculum in Mathematics and Science. Retrieved from Boston College, TIMSS & PIRLS International Study Center website: https://timssandpirls.bc.edu/timss2019/encyclopedia/

Kraft, M. A., & Monti-Nussbaum, M. (2021). The Big Problem with Little Interruptions to Classroom Learning. AERA Open, 7. https://doi.org/10.1177/23328584211028856

Martin, B. (2008). Obstacles to Academic Integrity. Proceedings of the 3rd Asia-Pacific Conference of Educational Integrity: Creating a Culture of Integrity. University of South Australia

Orbe, J. R., Espinosa, A. A., & Datukan, J. T. (2018). Teaching chemistry in a spiral progression approach: Lessons from science teachers in the Philippines. *Australian Journal of Teacher Education*, *43*(4), 17–30. https://doi.org/10.14221/ajte.2018v43n4.2

Perez, J. (2020). A Scoping Review on the Implementation of Spiral Progression. *Journal of Academic Research*, 11-22.

Relucio, F.C. & Palaoag, T. D. (2018). "Sentiment analysis on educational posts from social media," in Proceedings of the 9th International Conference on E-Education, E-Business, E-Management and E-Learning, 99–102.

Resurreccion, J. A., & Adanza, J. (2015). Spiral Progression Approach in Teaching Science in Selected Private and Public Schools in Cavite. 3(2010), 1–12. https://doi.org/10.17758/uruae.uh0516148

Rivera, J. G (2017). "Articulating the foundations of Philippine K to 12 curriculum: learner-centeredness," AsTEN Journal of Teacher Education, 2(1).

Rivera, J. G. (2018). Articulating the Foundation of Philippine K to 12 Curriculum: Learner Centeredness. *AsTEN Journal of Teacher Education*, 56- 70.

Samala, H. D. (2017). Spiral Progression Approach in Teaching Science: A Case Study. Polytechnic University of the Philippines. http://dx.doi.org/10.18502/kss.v3i6.2404

Sanchez J. M. (2017). Integrated macro-micro-symbolic approach in teaching secondary Chemistry. Kimika. 28 (2), 22-29. DOI: 10.26534/kimika. v28i2.22-29

Squires, D. (2013). The Balanced Curriculum Model. SAGE Open 3:1,https://doi.org/10.1080/00098655.2012.657723

Tirol, S. (2021). Spiral Progression of Biology Content in the Philippine K to 12 Science Curriculum. *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, *4*(6), 20–27.

Yu, J., Li, C., & Li, G. (2022). Alignment between biology curriculum standards and five textbook editions: a content analysis. *International Journal of Science Education*, 1–20. https://doi.org/10.1080/09500693.2022.2119621

Yumuşak, G. K. (2016). An Analysis of the Science Curricula in Turkey with Respect to Spiral Curriculum Approach. *Journal of Education and Practice,* 7(9), pp. 99-105 DOI: https://files.eric.ed.gov/fulltext/EJ1095823.pdf

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