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ASSOCIATION OF SCIENCE TEACHING EFFECTIVENESS IN SPIRAL PROGRESSION APPROACH AND SCIENCE TEACHING EFFICACY BELIEF AMONG SCIENCE TEACHERS

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Abstract
Spiral progression approach (SPA), a key element of the K-12 curriculum, aims to gradually reinforce learning by revisiting topics throughout the schooling of learners. Despite efforts, issues persist in the application of SPA, impacting the behavior of junior high school science teachers. The main concerns include the need for training during curriculum restructuring. This study examined the science teaching effectiveness in SPA and the efficacy beliefs of JHS science teachers. Relationships between teaching effectiveness and teaching efficacy were explored among 28 private JHS science teachers in Cabanatuan City, Nueva Ecija. Validity and reliability testing confirmed the consistency of the Self-Perceived Science Teaching Effectiveness Instrument. Teachers scored above average in science teaching effectiveness and teaching efficacy. Correlational analysis revealed a strong association between science teaching effectiveness and teaching efficacy. Specifically, teaching efficacy significantly influenced training and workshops. Sociodemographic factors were not associated with teaching effectiveness in SPA.

Keywords: K to12 science, science education, spiral progression approach, teaching effectiveness, teaching efficacy

Introduction
Spiral progression approach (SPA) is integrated into education systems globally, including the K to 12 curriculum in the Philippines. The Department of Education (DepEd) claims SPA is a pivotal solution to the current education crisis in the Philippines. A feature of the K to 12 curriculum, spiral education (Bruner,1960), progressively reinforces understanding by revisiting topics throughout schooling. Unlike linear methods, it revisits topics with increasing complexity, allowing deeper knowledge, and providing a unique pedagogical perspective. This is especially effective in enhancing student engagement, knowledge retention, and learning outcomes across contexts.

While the K to 12 curriculum aims to enhance educational quality, challenges for teachers in content mastery and pedagogical strategies were encountered in the

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transition. Despite ongoing efforts, teachers still struggle to implement the curriculum. The transition leads to teacher burnout due to limited resources, lack of professional development, and the need for innovative methods (Hernandez, 2021). The novel approach demanded more professional development, challenging Filipino science teachers in its implementation. SPA requires a new pace in the delivery of learning content, which can be too fast or too slow, requiring teachers for extensive subject matter understanding. In addition, the success of this implementation may vary based on factors such as years of service, professional development, teaching load, and age, influencing instructional quality and content mastery (Orbe et al., 2020).

While there is a significant body of pedagogical research on SPA globally, few works investigated the effects of SPA on the teaching effectiveness of Junior High School (JHS) science teachers. Previous works that highlighted the benefits of SPA for Filipino learners scarcely examined the impact of SPA on science teachers (Ramos-Samala, 2018). Evaluating teaching effectiveness in SPA centers on the factors of training quality, pedagogical support, and comprehensive curriculum strategies (Murray, 2019). Most works suggest that insights into teacher behavior are invaluable for enhancing training programs for curriculum development. Thus, this study aims to understand the behavior of science teachers on SPA to understand their beliefs as the main drivers of curriculum development. In this study, the researcher primarily questions the relationship between the self-perceived science teaching effectiveness in SPA and science teaching efficacy belief among JHS Science teachers. This was achieved by the following inquiries: What are teaching efficacy beliefs and perceived teaching effectiveness in SPA of science teachers? What is the relationship between the perceived science teaching effectiveness in SPA and the science teaching efficacy belief? What is the relationship between socio-demographics and perceived science teaching effectiveness?

Method

This study employed both descriptive and correlational approaches in investigating the science teaching effectiveness in SPA to establish the relationships of the identified factors from the insights of several works on SPA in science education (Paring et al., 2021; Resurreccion & Adanza, 2015; and Tapanan et al., 2021.) Demographic information and science teaching efficacy belief were assigned as independent variables, whereas perceived science teaching effectiveness in SPA was dependent. This approach synthesized the findings to understand the relationship between teacher demographics, understanding of SPA benefits, challenges incurred in SPA, articulation of learning contents, and the role of professional development.

Data gathering

A complete enumeration of science teachers was performed among private schools in Cabanatuan City, Nueva Ecija that offered JHS in the school year 2023-2024. This was utilized to ensure that respondents met the relevant criteria, homogeneity, and capture the whole population. The respondents comprised 28 JHS Science teachers from 14 private institutions in Cabanatuan City, Nueva Ecija. Private schools were purposively selected due to the higher levels of support from

social groups, stronger academic-related self-concept, and higher achievement goals (Bernardo et al., 2015).

Data was acquired through a questionnaire administered via paper-and-pen and an online version that was accessible through a secure platform. Follow-up was organized through multiple online or physical correspondence with the immediate supervisor. The subject was tagged unavailable following five follow-up attempts in the duration of data collection. The request to conduct survey questionnaires was secured by the institution head. Ethical considerations were ensured to respect the confidentiality of respondents and adhere to appropriate practices. Informed consent was obtained from all respondents before their involvement. Personal identifiers were separated from the responses to warrant anonymity. All data collected from respondents were stored in a secure electronic database.

Instrument

The 57-item questionnaire was divided into three sections, namely, the socio-demographic profile, the Self-Perceived Science Teaching Effectiveness Instrument (SSTEI), and the Science Teaching Efficacy Belief Instrument for In-service Teachers (STEBI-A). STEBI-A is an established tool to measure the self-efficacy beliefs of in-service teachers developed by Riggs and Enochs (1990). It is a 25-item questionnaire that assesses the beliefs and ability of teachers to effectively teach science. It uses a five-point Likert scale where respondents rate their agreement with various statements on distinct aspects of teaching, including instructional strategies, classroom management, and student engagement. SSTEI is a 32-item, self-administered questionnaire that measures science teaching effectiveness. Four factors were identified as variables of teaching effectiveness. Specifically, understanding of the general benefits of SPA implementation (Bueno, 2023), challenges in implementing SPA (Quintos et al., 2022), articulation of science learning contents (Samson et al., 2021), and training and professional development (Quintos et al., 2022). Each component contained eight behavioral checklist items. A five-point Likert scale was utilized to measure the degree of agreement or disagreement in their responses, where: 5 - Strongly Agree, 4 - Agree, 3 - Uncertain, 2 - Disagree, and 1 - Strongly Disagree. This weighted means verbal description and interval are shown in Table 1.

Table 1. Interval scale and description of SSTEI items

Range	Description
4.21 - 5.00	Strongly Agree
3.41 - 4.20	Agree
2.61 - 3.40	Uncertain
1.81 - 2.60	Disagree
1.00 - 1.80	Strongly Disagree

Content appropriateness was ensured through reviews in refining the validity, relevance, and appropriateness of each item with experts. Internal consistency was assessed using Cronbach's alpha coefficient (Bland & Altman, 1997) presented in Table 2. The understanding of general SPA benefits was rated as excellent (α = 0.93). The challenges in implementing SPA were rated as good (α = 0.83). Articulation of science learning contents also received an excellent rating (α =

0.92), and training and professional development were considered acceptable (α = 0.73). Overall, it demonstrated "Good" internal consistency (α = 0.85).

Table 2. Cronbach's alpha values of SSTEI in SPA items

SSTEI Variable	Item	α	Remark
Understanding of General SPA Benefits	A1–A8	0.93	Excellent
Challenges in Implementing SPA	B1–B8	0.83	Good
Articulation of Science Learning Contents	C1–C8	0.92	Excellent
Training and Professional Development	D1–D8	0.73	Acceptable
Mean of α	n = 32	0.85	Good

Data analysis

Data analysis employed range, frequency, percentage, and descriptive approaches. Age was delineated by equal ranges based on highest and lowest values. Teaching experience followed the ranges by Quintos et al. (2022). Teaching load and auxiliary roles were treated as binary variables. Weighted means were used to interpret scores from SSTEI and STEBI-A. The Shapiro-Wilk test assessed normality. Similarly, Spearman's Rho correlation was used due to the non-normal distribution of data to test the relationship between SSTEI scores, STEBI-A scores, and sociodemographics. Analysis was performed using Jeffreys Amazing Statistics Program (JASP; version 0.18.3; JASP Team, 2020). Testing at significant levels of 0.05, 0.01, and 0.001 enabled ensured robust data interpretation.

Findings and Discussion

A summary of demographic information is shown in Table 3. Respondents included 28 teachers, predominantly female, with males covering a smaller segment. The most common age was 23 to 35 years old. The most represented institutions were Nueva Ecija University of Science and Technology, followed by Amazing Grace Christian School, Good Samaritan Colleges, and MV Gallego Foundation Colleges, respectively. Most have an entry-level position while the highest among the respondents is Professor IV. The highest administrative auxiliary role was that of a school principal. In terms of education, most teachers hold a bachelor's degree, primarily in Secondary Education, with General Science being the most common. Three respondents were holders of other degrees, namely, Biology, Chemistry, and Elementary Education. A smaller proportion hold a master's or a doctorate. Teaching experience revealed that most respondents have been practicing for five years or less. More than half of the respondents did not have extra duties.

The prevalence of female teachers aligns with trends in the teaching profession globally. A young workforce is suggested by the average age of the respondents in these private schools. This may be attributed to the transfer to government service because of higher salaries in public schools (Gonzales, 2021). All respondents in the study obtained their bachelor's degree in education as the basic requirement to practice in the Philippine JHS system. Often, younger teachers do not pursue post-bachelor's degrees because of their commitment to classroom teaching and the lack of adequate time for thesis requirements. The role of science teachers as laboratory coordinators underscores the multifaceted roles they play in schools (Barrios et al., 2023). Science teacher that earns non-science teaching loads

raise the possibility of difficulties in maintaining a strong emphasis on science education and may be indicative of the situation of teachers in private schools (Antipolo& Danilo, 2021).

Table 3. Profile of private JHS science teachers in Cabanatuan City, Nueva Ecija

Sample Characteristic		N = 28	%
Gender	Male	5	17.86
	Female	23	82.14
Age	23 to 35	20	71.43
	36 to 47	7	25.00
	48 to 60	1	3.57
Educational	Bachelor's	21	75.00
	Master's	5	17.86
	Doctorate	2	7.14
Teaching experience	5 and below	15	53.57
	6 to 10	5	17.86
	11 to 15	4	14.29
	21 and above	4	14.29
Teaching load	Full science load	17	60.71
	With a partial non-science load	11	39.29
Additional designation	Yes	12	42.86
	No	16	57.14

Science teaching efficacy belief of science teachers

In Table 4, respondents agreed with most statements (M = 4.10) on their teaching efficacy. Specifically, they seek better ways to teach science (M = 4.61) and feel confident in their ability to teach science concepts effectively (M = 4.32). They also strongly disagreed with the notion that they generally teach science ineffectively (M = 4.61) and that increased effort in science teaching yields a minor change in student achievement (M = 4.29). However, some uncertainties and areas of disagreement emerged, such as uncertainty about possessing the necessary skills to teach science (M = 3.04) and uncertainty regarding the impact of effective science teaching on students with low motivation (M = 3.14).

Despite reservations, the teachers demonstrated high confidence in their ability to effectively teach science concepts. High efficacy beliefs among respondents are the main driver of increased student engagement and teaching performance. This is demonstrated by actively innovating and employing strategies to enhance student performance in classes, thus, strongly opposing that efforts yield minor changes in student achievement.

Table 4. Weighted mean rating of science teaching efficacy belief instrument for in-service teachers (STEBI)-A

STEBI- A Statement	WM[a]	VD[b]
When a student does better than usual in science, it is often because the teacher exerted a little extra effort.	4.14	A
I am continually finding better ways to teach science.	4.61	SA
Even when I try very hard, I don't teach science as well as I do most subjects.*	4.18	D

STEBI- A Statement	WM[a]	VD[b]
When the science grades of students improve, it is most often due to their teacher having found a more effective teaching approach.	4.29	SA
I know the steps necessary to teach science concepts effectively.	4.32	SA
I am not very effective in monitoring science experiments.*	4.14	D
If students are underachieving in science, it is most likely due to ineffective science teaching.	3.18	U
I generally teach science ineffectively. *	4.61	SD
The inadequacy of a student's science background can be overcome by good teaching.	4.32	SA
The low science achievement of some students cannot generally be blamed on their teachers.	4.04	A
When a low-achieving child progresses in science, it is usually due to extra attention given by the teacher.	4.04	A
I understand science concepts well enough to be effective in teaching elementary science.	4.21	SA
Increased effort in science teaching produces little change in some students' science achievement.*	4.29	SD
The teacher is generally responsible for the achievement of students in science.	4.04	A
Students' achievement in science is directly related to their teacher's effectiveness in science teaching.	4.00	A
If parents comment that their child is showing more interest in science at school, it is probably due to the performance of the child's teacher.	3.93	A
I find it difficult to explain to students why science experiments work.*	4.29	SD
I am typically able to answer students' science questions.	4.25	SA
I wonder if I have the necessary skills to teach science.	3.04	U
Effectiveness in science teaching has little influence on the achievement of students with low motivation.*	3.14	U
Given a choice, I would not invite the principal to evaluate my science teaching.*	4.32	SD
When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better.*	4.18	D
When teaching science, I usually welcome student questions.	4.57	SA
I don't know what to do to turn students on to science.*	4.29	SD
Even teachers with good science teaching abilities cannot help some kids learn science.*	4.18	D
Average STEBI-A Score	4.10	A

Note. [a]Weighted Mean, [b]Verbal description, "SA" Strongly agree, "A" Agree, "U" Uncertain, "D" Disagree, "SD" Strongly disagree.

Teachers also focus on enhancing curriculum enhancement, improving instructional materials, and ensuring facilities meet student needs. While hesitations surfaced regarding readiness to teach and their impact on low student motivation, Nietes (2023) argued that science teachers possess the necessary skills and attitudes to teach effectively.

Self-perceived science teaching effectiveness in SPA of science teachers

Understanding of general benefits of SPA. In Table 5, the respondents strongly agreed that SPA fosters lesson continuity (M = 4.64), allows students to apply prior knowledge (M = 4.46), and enhances retention and mastery of topics

(M = 4.32). They also agreed that SPA aligns with learner development (M = 4.46) and promotes topic integration (M = 4.64). Additionally, SPA was noted for encouraging tailored tasks (M = 4.57), supporting teacher collaboration (M = 4.57), and being efficient in resource-limited contexts (M = 4.25). Overall, SPA was positively received (M = 4.49) for its effectiveness in promoting continuous, integrated, and developmentally appropriate learning.

Table 5. Rating of understanding of general SPA benefits

SSTEI Statement	WM[a]	VD[b]
SPA enables the continuity of lessons from simple to complex.	4.64	SA
SPA allows the student to use their prior knowledge in new situations.	4.46	SA
SPA strengthens retention and mastery of topics and skills as they are revisited and consolidated.	4.32	SA
Learners learn topics and skills appropriate to their development stage.	4.46	SA
SPA helps students realize the importance of integrating topics from other subjects.	4.64	SA
SPA encourages teachers to accommodate the task to learners.	4.57	SA
Teachers were able to collaborate to ensure that holistic and coherent learning was provided over some time.	4.57	SA
This approach is efficient in a field in which resources for staff development are limited.	4.25	SA
Mean/Overall Interpretation	4.49	SA

Note. [a]Weighted Mean, [b]Verbal description, "SA" Strongly agree, "A" Agree, "U" Uncertain, "D" Disagree, "SD" Strongly disagree.

The respondents displayed a strong insight into the benefits of SPA. Respondents highly rated it for fostering lesson continuity and enabling the application of prior knowledge. Agreement existed on how repeated exposure facilitates learning in SPA that results in enhanced retention and mastery of topics. Respondents revisit topics with increasing complexity in each grade level. They also understood that SPA maintains student engagement and reinforces cumulative learning. SPA was considered beneficial for deepening student knowledge, promoting educator collaboration, and enhancing teaching effectiveness. This approach aids in developing content knowledge, fostering teacher discussions across grade levels, and encouraging the exploration of teaching methods. This positive perspective underscored the acceptance of SPA in promoting continuous, integrated, and developmentally appropriate learning, even in resource-limited contexts.

Table 6. Rating of challenges in implementing SPA

SSTEI Statement	WM[a]	VD[b]
Teachers find difficulty in connecting topics from one grade to another grade.	3.25	U
The learning materials provided are not enough.	3.25	U
Students show difficulty in recalling concepts learned during the previous grades.	3.96	A
Activities are not easily carried out because some parts require the knowledge learned from the previous grades.	3.75	A

SSTEI Statement	WM[a]	VD[b]
The teachers review the lesson from the previous grade before discussing the present lesson.	4.50	SA
Teachers face difficulties in ensuring that learners acquire knowledge and skills appropriate to their developmental stages.	4.00	A
Teachers find it challenging to strengthen retention and mastery of subjects as they are revisited and consolidated.	3.82	A
Enabling learners to gain valid experiences is a challenging aspect for teachers in the spiral curriculum.	3.82	A
Mean/Overall Interpretation	3.79	A

Note. [a]Weighted Mean, [b]Verbal description, "SA" Strongly agree, "A" Agree, "U" Uncertain, "D" Disagree, "SD" Strongly disagree.

Challenges in implementing SPA. In Table 6, SPA received varying views among teachers. Respondents were uncertain about the difficulty of connecting topics across grades (M= 3.25) and the sufficiency of learning materials (M= 3.25). However, they agreed that students have difficulty recalling concepts (M = 3.96) and activities requiring prior knowledge are hard to carry out (M = 3.75). They strongly agreed that previous lessons are reviewed before new ones (M = 4.50) and that acquiring age-appropriate knowledge and skills is challenging (M = 4.00). Unanimity was also observed in strengthening retention as subjects are revisited (M= 3.82) and providing valid experiences being challenging (M= 3.82). Overall, these implementation challenges were agreed upon (M= 3.79).

The findings revealed mixed sentiments on the perceived challenges to the implementation of SPA. Some positively perceived its impact on learners, while the negative perceptions from teachers may be attributed to the need for enhanced curriculum and required knowledge for the mastery of learning contents. Nonetheless, challenges in recalling previous learning contents were observed to lead to difficulties in activities requiring prior knowledge. Consensus was apparent on the provision of age-appropriate skills and strengthening the mastery and retention of content. However, enabling learners to gain valid experiences was also a challenge for the respondents. Orbe et al. (2020) also linked that challenges for teachers are often related to content, pedagogy, assessment, teacher competence, training sufficiency, and resource adequacy. Despite this, the respondents still value the learner-centered design of SPA, promoting problem-based learning and science process skills. For science teachers, they believe that this approach aims to make science more relevant and engaging for students (Tirol, 2022).

Table 7. Rating of articulation of science learning contents

SSTEI Statement	WM[a]	VD[b]
The concepts and skills in science learning areas are presented with increasing levels of complexity from one grade level to another.	4.61	SA
There is an integration of knowledge and skills across different disciplines.	4.57	SA
The presentation of the lessons is broadened and deepened each time a concept is revisited.	4.57	SA
There is integration of various concepts on each topic encountered.	4.50	SA
The lessons are extended in a more elaborate and comprehensive teaching style.	4.50	SA

SSTEI Statement	WM[a]	VD[b]
The topics discussed in the previous years are revisited in the present year.	4.46	SA
There is a continuity of lessons in the same concept of science in all grade levels.	4.57	SA
The topics are reviewed from the previous grade level before introducing new topics.	4.68	SA
Mean/Overall Interpretation	4.56	SA

Note. [a]Weighted Mean, [b]Verbal description, "SA" Strongly agree, "A" Agree, "U" Uncertain, "D" Disagree, "SD" Strongly disagree.

Articulation of science learning contents in SPA. Results indicated strong agreement among the respondents on positive aspects of science learning content articulation (See Table 7). They strongly agreed that concepts and skills progress in complexity across grades (M = 4.61), integrate knowledge across disciplines (M = 4.57), depth of lessons increases with revisited concepts (M = 4.57), and integrate concepts on each topic (M = 4.50). Strong agreement was observed on extended, comprehensive teaching (M = 4.50) and revisiting topics annually (M = 4.46). Additionally, they agreed on lesson continuity (M = 4.57) and reviewing topics before new lessons (M = 4.68). Overall, these findings stressed strong agreement on the role of articulation of science learning contents (M = 4.56).

Science teachers supported the progressing science concepts across grade levels and subjects. SPA positively impacts science articulation due to its learner-centered nature (Tirol, 2022). SPA is praised for vertical and horizontal sequencing of learning competencies to enhance learning outcomes and teaching effectiveness (Igcasama et al., 2019). Respondents perceive vertical articulation as beneficial for providing a deeper understanding of concepts through recall and revisit strategies. SPA ensures careful sequencing of learning competencies and increasing complexity of subject matter across grades.

Training and professional development in SPA. The results (See Table 8) showed strong agreement on the positive role of training and development opportunities among respondents. Respondents positively regarded workshops for supporting their development (M = 4.50) and conferences contributing to their growth (M = 4.64). A similar pattern is also observed in online courses and webinars for strengthening continuous learning (M = 4.61). Graduate education was seen to enhance overall teaching competence (M = 4.46). Mentorship programs were valued for guidance and support (M = 4.68), observation promoted shared learning (M = 4.68), action research improved teaching methods (M = 4.39), and professional associations were noted for enhancing competency (M = 4.57). Overall, these opportunities were strongly upheld for their benefits (M = 4.57).

Table 8. Mean rating of training and professional development

SSTEI Statement	WM[a]	VD[b]
In-service workshops are available for my professional development.	4.50	SA
Conferences contribute to my professional growth as a JHS teacher.	4.64	SA
Online courses and webinars support my continuous learning.	4.61	SA
Graduate programs positively impact my overall professional competence as a JHS teacher.	4.46	SA

SSTEI Statement	WM[a]	VD[b]
Mentorship programs offer guidance and support for my career development as a JHS teacher.	4.68	SA
Peer observation and collaboration opportunities promote shared learning among JHS teachers.	4.68	SA
Action research opportunities let me actively improve my teaching methods.	4.39	SA
Memberships in professional teacher associations can enhance my competency as a JHS teacher.	4.57	SA
Mean/Overall Interpretation	4.56	SA

Note. [a]Weighted Mean, [b]Verbal description, "SA" Strongly agree, "A" Agree, "U" Uncertain, "D" Disagree, "SD" Strongly disagree.

The effectiveness of professional development in enhancing teaching effectiveness and pedagogical practices was also observed by Gonzales et al. (2023). This is essential in overcoming modern technology to effectively apply SPA (Perez et al., 2020). Workshops were noted to improve competence in SPA, while seminars are beneficial in aligning practices with K-12 competencies, particularly due to distance learning during the COVID-19 pandemic (Lansangan & Orleans, 2023). Despite fewer post-baccalaureate degrees, graduate education was perceived to empower teaching adaptability, improve educational research, and update science content knowledge. Mentorship was also valued for its impact on professional development, aligning with findings by Confesor and Belmi (2022). Peer observations promote shared learning among colleagues was favored by science teachers and appreciated for creating a supportive environment for learning and growth.

Teaching efficacy and perceived teaching effectiveness

Shapiro-Wilk value deviated from normal distribution (W = 0.88, p= 0.004), thus, Spearman's Rho correlation examined relationships between SSTEI and STEBI-A scores as shown in Table 9. The analysis indicated a strong positive correlation and significant relationship between SSTEI and STEBI-A scores (ρ = 0.58, p = 0.001). This suggests that higher self-perceived effectiveness in SPA is linked with higher science teaching efficacy beliefs. Meiyanti and Hidayat (2022) also observed that teaching efficacy positively influences teaching effectiveness.\

Table 9. Spearman's Rho correlation of STEBI-A and SSTEI scores

STEBI-A Association	P	p[a]	Interpretation	Remark
Overall Science Teaching Effectiveness	0.578**	0.001	Significant	Strong
Understanding of General SPA Benefits	0.505**	0.006	Significant	Strong
Challenges in SPA implementation	0.222	0.257	Not significant	Weak
Articulation of Science Learning Contents	0.409*	0.031	Significant	Strong
Training and Professional Development	0.661***	<0.001	Significant	Strong

Note. [a]Significant at *indicates p <0.05, **indicates p <0.01, *** indicates p <0.001.

Science teaching efficacy and challenges in implementing SPA. Conversely, the relationship between the perceived challenges in SPA and STEBI-A was negligible ($\rho = 0.22$, $p = 0.26$). This suggests that the impact of teaching efficacy among teachers has a minimal effect on the perceived challenges in SPA. Several factors influence how science teachers manage challenges in SPA (Dokme & Koyunlu Unlu, 2023). Previous findings indicate that teachers with high teaching efficacy beliefs maintain resilience despite challenges in implementing SPA (Baron & Cruz, 2023). Respondents demonstrate adaptability to challenges such as resource scarcity and integration issues. The learner-centered nature of SPA and support for science teachers enable them to maintain high levels of teaching efficacy. The teaching experiences during the COVID-19 pandemic demonstrate resilience in teaching efficacy through adaptive methods, support mechanisms, and hybrid learning despite constraints.

Science teaching efficacy and articulation of science learning contents in SPA. Articulation of learning contents was strongly linked ($\rho = 0.41$, $p = 0.03$) to science teaching efficacy. This suggests that greater teaching efficacy belief was associated with increased appreciation of science articulation. Initially, respondents agreed that SPA is advantageous for the delivery of learning content because it aligns curriculum, instruction, and assessment coherently. SPA also positively influences content delivery and transitions across the four subject domains/areas in JHS science. Resureccion and Adanza (2015) emphasized that teachers are required to have the necessary mastery in all these areas to maximize SPA. Vertically, it allows for the development of understanding by presenting science learning contents at increasing levels of complexity. This systematic learning progression builds foundational knowledge. Horizontally, SPA facilitates interdisciplinary connections and the integration of other subjects, enhancing cognitive, emotional, and behavioral engagement for learners. Through articulation, gaps can be effectively addressed by teachers to promote deeper learning experiences in science.

Science teaching efficacy and training and professional development in SPA. Training also significantly showed a relationship with STEBI-A ($\rho = 0.66$, $p<0.001$). This suggests that high teaching efficacy beliefs influence how teachers recognize the benefits of training and professional development in SPA. The results were consistent with several studies that training and professional development benefit teaching efficacy among science teachers, especially in domain-specific knowledge and strategies (Walag et al., 2020). Particularly, STEM training and seminars increase teaching efficacy by promoting accomplishment, emotional stimulation, vicarious experiences, and verbal persuasion (O'Dwyer et al., 2023). Professional development has been shown to significantly enhance teaching efficacy by improving SPA strategies, content knowledge, views of science inquiry, and beliefs about reform-based teaching.

Science teaching effectiveness and sociodemographic factors

No significant relationship ($\rho = -0.06$, $p= 0.77$) was found between gender ($\rho = -0.10$, $p= 0.61$), highest educational attainment ($\rho = -0.17$, $p= 0.40$), teaching experience ($\rho = -0.54$, $p = 0.79$), and auxiliary roles ($\rho = -0.79$, $p= 0.61$). Teachers perceive SPA benefits or challenges regardless of gender. Although higher degrees

generally enhance teaching effectiveness, the absence of a significant relationship between educational attainment and teaching effectiveness might be attributed to the number of samples and the frequency of bachelor's degree holders. The lack of an effect of teaching effectiveness on teaching experience might imply that both new and experienced teachers face challenges with SPA implementation (Bartolome, 2023). While the relationship was weak overall, training and instruction showed variation in the auxiliary role of science teachers. Wherein, teachers without auxiliary roles may dedicate more time to classroom instruction, while those with such roles value training opportunities.

Conclusion

The above-average overall science teaching efficacy belief is a good indicator of the positive teaching behavior of private JHS teachers in Cabanatuan City, Nueva Ecija. The overall self-perceived science teaching effectiveness of private JHS teachers in Cabanatuan City, Nueva Ecija is above average on all four aspects of science teaching effectiveness in the spiral progression approach. Self-perceived science teaching effectiveness has a significant positive relationship with science teaching efficacy belief when the combined rating of all aspects is considered. In particular, the perceived challenges in the implementation of the spiral progression approach have the weakest effect on science teaching efficacy belief. No significant relationship in SSTEI scores was associated the gender, educational attainment, teaching experience, and auxiliary function among JHS Science teachers in Cabanatuan City. These findings provide a clearer view of the perspectives of science teachers at the secondary level on the utilization of the spiral progression approach in the current basic education curriculum.

The authors recommend expanding the study locality to schools across Nueva Ecija for a more diverse sample based on sociodemographic factors, school types, and grade levels. Further, future training and workshops should address science teaching strategies and content mastery. For educators, conducting action research on SPA should be done to understand the nature of teachers in their locality and refine teaching strategies in their context. Additionally, developing and using the SSTEI tool would provide stronger insights into science education. Lastly, policymakers and stakeholders should be engaged to integrate these findings into teacher education programs and curricular reforms.

References

Antipolo, A. M. R., & Danilo Jr, V. (2021). Filipino prospective teachers' experiences in teaching in K12 science curriculum: A cross-sectional research. *Jurnal Pendidikan Biologi Indonesia, 7*(1), 1-10. https://doi.org/10.22219/jpbi.v7i1.15468

Baron, J. V., & Cruz, J. A. D. (2023). The spiral progression approach in teaching science: Its volatilities, uncertainties, complexities, and ambiguities (VUCA). *Journal of Social, Humanity, and Education, 3*(2), 89-103. https://doi.org/10.35912/jshe.v3i2.1194

Barrios, A. R., Claudio, A. A., Bilonoac, L. C., Beldia, L. L. L., & Sosas, R. V. (2023) Workload and teaching efficiency of high school teachers in Southern Baptist College, Incorporated, Mlang, Cotabato, Philippines. *Journal of Research & Method in Education, 13*(1), 39-47. https://doi.org/10.9790/7388-1301013947

Bartolome, D. J. (2023). Spiral progression approach in teaching mathematics: Its implementation in the public secondary school. *Quantum Journal of Social Sciences and Humanities, 4*(3), 81-100. https://doi.org/10.55197/qjssh.v4i3.226

Bernardo, A. B., Ganotice, F. A., & King, R. B. (2015). Motivation gap and achievement gap between public and private high schools in the Philippines. *The Asia-Pacific Education Researcher, 24*, 657-667. https://doi.org/10.1007/s40299-014-0213-2

Bland, J. M., & Altman, D. G. (1997). Statistics notes: Cronbach's alpha. *BMJ, 314*(7080), 572. https://doi.org/10.1136/bmj.314.7080.572

Bruner, J. S. (1960). *The process of education*. Cambridge, MA: Harvard University Press.

Bueno, K. D. M. (2023). Mathematics teachers' assessment of spiral progression approach. *International Journal of Research Publications, 123*(1), 524-538. https://doi.org/10.47119/IJRP1001231420234721

Confesor, R. F., & Belmi, R. M. (2022). Structure, activities, and teacher development in the Philippine science teachers' community of practice. *International Journal of Learning, Teaching and Educational Research, 21*(6), 71-89. https://doi.org/10.26803/ijlter.21.6.5

Dokme, İ., & Koyunlu Ünlü, Z. (2023). An effective intervention using STEM instruction for improving preservice science teachers' self-efficacy. *Research in Science & Technological Education, 42*(4), 930-951. https://doi.org/10.1080/02635143.2023.2209847

Gonzales, M. G., Cagurin, G. B., Bacarrisas, P. G., Guimary, F. M., Gracia Jr, A. G., & Walag, A. M. P. (2023). A project monitoring study on the improvement of elementary science teacher's science teaching efficacy through a flexible online training course. *Canadian Journal of Family and Youth/Le Journal Canadien de Famille et de la Jeunesse, 15*(3), 1-15. https://doi.org/10.29173/cjfy29904

Gonzales, N. J. (2021). Migration from private to public institutions: A phenomenological study on transitional challenges from teachers' viewpoints. *International Research Journal of Science, Technology, Education, and Management, 1*(2), 50-64. https://doi.org/10.5281/zenodo.5726283

Hernandez, L. L. (2021). Experiences of science teachers in implementing spiral approach. *International Journal of Innovative Science and Research Technology, 6*(3), 866-870. https://doi.org/10.5281/zenodo.7317262

Igcasama, R. M., Borinaga, I. A., Mutia, E. C., Suarez, C. L., & Balogo, J. C. (2019). Explaining the academic performance of grade 7 students as influenced by social media. *Journal of Physics: Cnference Series, 1254*(1), 012039. https://doi.org/10.1088/1742-6596/1254/1/012039

Lansangan, R. V., & Orleans, A. V. (2023). Experiences of Filipino secondary science teachers in assessing students in flexible learning during the COVID-19 pandemic. *European Journal of Education and Pedagogy*, *4*(2), 182-193. https://doi.org/10.24018/ejedu.2023.4.2.630

Meiyanti, F., Hardienata, S., & Hidayat, N. (2022). The correlation between self-efficacy and pedagogic competence with teacher teaching effectiveness. *Pedagonal: Jurnal Ilmiah Pendidikan, 6*(1), 107-119. https://doi.org/10.55215/pedagonal.v6i1.4935

Murray, J. W. (2019). Reclaiming teaching for teacher education: Towards a spiral curriculum. *Beijing International Review of Education, 1*(2-3), 259-276. https://doi.org/10.1163/25902539-00102015

Nietes, S. L. (2023). Science teachers' capabilities in teaching biology in the JHS: Bases for competency enhancement program. *Praxis international journal of social science and literature, 6*(5), 103-117. https://doi.org/10.51879/PIJSSL/060512

O'Dwyer, A., Hourigan, M., Leavy, A. M., & Corry, E. (2023). 'I have seen STEM in action and it's quite do-able!' the impact of an extended professional development model on teacher efficacy in primary STEM education. *International Journal of Science and Mathematics Education, 21*(1), 131-157. https://doi.org/10.1007/s10763-023-10361-2

Orbe, J. R., Naidu, V. L., Ng, J., & Reyes, V. (2020). 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

Paring, I. R. B., Cereno, A. C. C., & Decano, R. S. (2021). Determining factors to students' science achievement in the implementation of K to 12 spiral progression approach: A mixed method. *International Journal of Educational Research Review, 6*(1), 46-54. https://doi.org/10.24331/ijere.815698

Perez, J. C., Bongcales, R., & Bellen, J. A. (2020). A scoping review on the implementation of the spiral progression approach. *Journal of Academic Research, 1*(1), 11-22. https://www.semanticscholar.org/paper/A-Scoping-Review-on-the-Implementation-of-the-Perez-Bongcales/d77834e69d21c3a6ee1412d51302b895ef8f6972

Quintos, C. A., Caballes, D. G., Gapad, E. M., Valdez, M. R., Necio, C. R., & Ortega, R. S. (2022). Analysis of science teachers on the spiral progression approach as a framework for school program design. *International Journal of Research in Engineering and Science (IJRES), 10*(3), 49-56.

Ramos-Samala, H. (2018). Spiral progression approach in teaching science: A case study. *KnE Social Sciences, 3*(6), 555-567. https://doi.org/10.18502/kss.v3i6.2404

Resurreccion, J. A., & Adanza, J. (2015). Spiral progression approach in teaching science in selected private and public schools in Cavite. *Proceedings of the DLSU Research Congress, 3*, 1-12. https://doi.org/10.17758/uruae.uh0516148

Riggs, I., & Enochs, L. (1990). Toward the development of an elementary teacher's science teaching efficacy belief instrument. *Science Education, 74*(6), 625-637. https://doi.org/10.1002/sce.3730740605

Samson, N. L., Boyles, L. Z., & Arnado, A. A. (2021). Spiral progression approach: Digital literacy and competency in teaching science. *International Journal of Education and Research, 9*(9), 111-120.

Tapanan, H. E., Antig, M. G., & Tapanan, M. L. J. (2021). Assessment of teacher' performance and the spiral progression approach in mathematics. *International Journal of Innovative Science and Research Technology, 6*(1), 668-675.

Tirol, S. L. (2022). Spiral progression approach in the K to 12 science curriculum: A literature review. *International Journal of Education, 10*(4), 29-44. https://doi.org/10.5121/ije.2022.10403

Walag, A. M. P., Fajardo, M. T. M., Guimary, F. M., & Bacarrisas, P. G. (2020). Science teachers' self-efficacy in teaching different K to 12 science subjects: The case of Cagayan De Oro City, Philippines. *Science International, 32*(5), 587-592.