THE ADVANCED SOCIAL SCIENCE IN RESEARCH JOURNAL
2026, Vol. 1, No. 2, 429 – 446
http://dx.doi.org/10.11594/assrj.01.02.18

Research Article

Big-Idea Coherence Beliefs as Predictors of Instructional Integration Practices Among Public Secondary Biology Teachers in Masbate, Philippines

Erdee Cajurao[1*], John Carlo Mortel[1], Edna Padre[2], Roel Ang[3]

[1]Dr.Emilio B. Espinosa Sr. Memorial State College of Agriculture and Technology, Mandaon, Masbate, 5411, Philippines
[2]President Ramon Magsaysay State University, Iba, Zambales, 2201, Philippines
[3]Nueva Ecija University of Science and Technology, Cabanatuan City, Nueva Ecija, 3100, Philippines

Article history:
Submission March 2026
Revised March 2026
Accepted April 2026

**Corresponding author:*
E-mail:
eccajurao@debesmscat.edu.ph

ABSTRACT

This descriptive-correlational study examined the relationship between big-idea coherence beliefs and instructional integration practices among 45 public secondary Biology teachers in Masbate, Philippines. We used two researcher-made instruments, the Big-Idea Coherence Belief Scale (BICoBS) and the Instructional Integration Practice Inventory (IIPI), both with excellent internal consistency (Cronbach's alpha: BICoBS = 0.93; IIPI = 0.97). The study described teachers' belief and practice levels, tested for group differences by experience, and examined the correlation between the two variables. Results showed a very high level of big-idea coherence belief (M = 4.69, SD = 0.31), strongest in the cross-cutting concepts domain (M = 4.74). Respondents similarly reported a very high level of instructional integration practice (M = 4.44, SD = 0.52), highest in assessment alignment (M = 4.51) and interdisciplinary linking (M = 4.49). Thematic unit planning yielded the lowest domain mean (M = 4.33). Kruskal-Wallis tests found no significant differences in big-idea coherence beliefs (H = 2.27, p = .519) or instructional integration practices (H = 0.51, p = .916) across experience groups. Both orientations are therefore uniformly distributed regardless of career stage. Spearman rank-order correlation revealed a significant moderate positive relationship between big-idea coherence beliefs and instructional integration practices (r_s = .550, $p < .001$), with all domain-level correlations also significant (r_s = .404 to .428). Content analysis of five lesson plans submitted by teachers revealed documentary evidence of explicit big-idea framing, systematic interdisciplinary linking, and conceptually demanding assessment tasks across multiple biology and science topics. These findings affirm that beliefs in conceptual coherence serve as meaningful predictors of integrative classroom behavior. We therefore underscore the importance of cultivating coherence-oriented pedagogical dispositions through professional development and pre-service teacher education in provincial Philippine settings.

How to cite:
Cajurao, E. et al. (2026). Big-Idea Coherence Beliefs as Predictors of Instructional Integration Practices Among Public Secondary Biology Teachers in Masbate, Philippines. *The Advanced Social Science In Research Journal*. 1(2), 429 – 446. doi: 10.11594/assrj.01.02.18

Keywords: *big ideas in science education, big-idea coherence beliefs, instructional integration, biology teachers, teacher beliefs*

Introduction

Masbate sits in the middle of the Philippine archipelago, a small island province in the Bicol region reached by ferry, small aircraft, and long hours of coastal travel. In its public secondary schools, Biology is often taught in classrooms that lack functioning microscopes, laboratory reagents, and stable internet access for reference materials. A typical Biology teacher here may handle five sections of forty to fifty learners, shuttle between campuses in different municipalities, and prepare lessons using the cascading templates of the Daily Lesson Log (DLL) with minimal access to in-person professional development. This is the setting in which we began the present examination. It is a setting rarely named in the international literature on science teaching, yet it is precisely the kind of place where the MATATAG Science Curriculum, the latest national reform of the Philippine Department of Education (DepEd, 2023), is now being implemented.

We began with a concrete puzzle. Teachers here, working under these conditions, continue to choose between two broad orientations every time they plan a lesson. One orientation treats Biology as a pile of terms and facts to be covered before the next periodic test. The other treats Biology as a web of connected explanations organized around big ideas, broad unifying principles that link diverse biological phenomena into a coherent whole (Chalmers et al., 2017; Harlen, 2010, 2017). The distinction is not merely theoretical. It shapes what students carry with them when they leave our classrooms, and it shapes how teachers use their limited instructional time. We wanted to know which orientation prevails among Biology teachers in Masbate, and whether what they believe actually reaches their lessons.

The coherence-oriented orientation has a clear theoretical grounding. Harlen (2010) formally articulated ten overarching ideas capable of explaining the diversity of natural phenomena students encounter from primary through secondary schooling. She argued that a smaller set of powerful ideas explains students' experiences more effectively than a sprawling catalogue of isolated topics (Harlen, 2017). The Philippine MATATAG Science Curriculum has since adopted this philosophy explicitly, defining a big idea as a statement central to learning that links numerous understandings into a coherent whole (DepEd, 2023). Cross-cutting concepts, principles such as Structure and Function, Patterns, and Systems Thinking, play a similar role in the Next Generation Science Standards (NGSS Lead States, 2013). Twyman and Hockman (2021) described these ideas as cognitive anchors that enable learners to see patterns and transfer understanding across contexts. Zaitsev (2021) argued that effective Biology instruction requires teachers to develop a conceptual vision, the capacity to identify meaningful patterns in natural phenomena and reveal their relations in the classroom.

The evidence, however, has been uneven. Research across different contexts reports a persistent mile-wide, inch-deep pattern in Biology instruction, where learners meet many topics but understand few (National Research Council, 2007; National Center for Education Statistics, 2004, as cited in Brownell and Tanner, 2012). Pajares (1992) established that teacher beliefs act as powerful filters on instructional decisions, often stronger than formal training or curriculum mandates. Ambusaidi et al. (2021) showed that Omani Biology teachers endorse reform-oriented beliefs yet default to content-focused, teacher-centered practice. Saad and BouJaoude (2012) found no consistent relationship between teachers' stated views and their observed classroom behaviors. Shulman's (1987) pedagogical content knowledge framework supplies one explanation: the capacity to transform subject matter into accessible, connected instruction depends on the teacher's conception of the discipline itself. Mapulanga et al. (2022) found that stronger perceived enactment of pedagogical content knowledge in Biology predicted more coherent learning outcomes. Cess-Newsome (1999) argued that teachers who see Biology as an integrated network teach in ways that reflect that coherence.

The international picture is mixed. Mapulanga et al. (2024) found that secondary Biology teachers in Zambia could articulate the importance of connecting concepts, yet their actual integration of pedagogical content knowledge components in lessons remained fragmented. Bravo Gonzalez and Reiss (2023) reported that Chilean teachers valued big ideas strongly, but their practical implementation varied with familiarity and institutional support. Tiu and Rabago (2025) noted that integrating broad competencies into subject-specific teaching is consistently difficult in constrained policy environments. Cleveland et al. (2017) documented how systems-thinking frameworks grounded in big ideas can provide a unifying paradigm in tertiary Biology, though the result hinges on the teacher's instructional choices.

In the Philippines, the K to 12 reform and now the MATATAG curriculum have pressed integrative teaching forward (DepEd, 2019, 2023). The spiral progression design philosophically aligns with big-idea coherence. The implementation story is less smooth. Barrot (2021) identified gaps in constructive alignment, instructional delivery, and teacher preparation that hinder the curriculum's integrative vision. Ligsanan and Peria (2024) documented challenges in resource availability, instructional time, and meaningful teacher engagement in curricular decision-making across Regions I, III, and V. Antipolo and Danilo (2021) found that prospective Biology teachers trained in a single science discipline struggle with the spiral curriculum's cross-disciplinary demands.

Three gaps encouraged us to pursue this study. First, most of the literature we cite comes from well-resourced settings with stable infrastructure. The Philippine island-province reality, intermittent electricity, long travel times between schools, and chronic shortages of laboratory materials, has no direct voice in that body of work. Second, teacher beliefs and teacher practice have usually been studied separately. The specific relationship between a teacher's conviction that Biology is a connected whole, a conviction we label big-idea coherence, and the actual classroom behaviors that express that conviction remains unexplored. Third, the small existing literature on Filipino Biology teachers' beliefs is largely qualitative in nature and from urban settings. The teachers in provinces such as Masbate have barely appeared in it.

We initiated this study to close those gaps. The inquiry had three concrete aims. We wanted to describe the level of big-idea coherence beliefs among public secondary Biology teachers in Masbate, to assess the extent of their instructional integration practices, and to determine whether the two are meaningfully related. We situated the work deliberately in one island province, in one curriculum moment, among teachers whose daily realities include limited laboratory equipment, a young teaching workforce, and the specific implementation of the MATATAG Science Curriculum in the Bicol region. We also treated the question as more than a narrow methodological one. Big-idea coherence beliefs sit at the intersection of social psychology, the study of attitudes and beliefs held within a professional group (Pajares, 1992), and public policy analysis, the study of how a government instrument such as the MATATAG curriculum reshapes professional behavior. A shift from fact-coverage toward coherence-oriented teaching is, at heart, a cultural shift in the pedagogical norms of a profession, and it is this kind of shift that the present study tracks.

Research Questions

This study examines Biology teachers' beliefs regarding big-idea coherence and their level of instructional integration practices in selected public secondary schools in Masbate, Philippines. Specifically, it seeks answers to the following questions:

1. What is the demographic profile of public secondary Biology teachers in Masbate in terms of age, gender, current teaching position, years of teaching experience in Biology, and highest educational attainment?
2. What is the level of belief in big-idea coherence among public secondary Biology teachers in Masbate?
3. What is the level of implementation of the instructional integration practices among the respondents in their classrooms?
4. Is there a significant difference in the respondents' belief in big-idea coherence

when grouped according to their years of teaching experience?

5. Is there a significant difference in the respondents' extent of instructional integration practices when grouped according to their years of teaching experience?
6. Is there a significant relationship between the Biology teachers' belief in big-idea coherence and their instructional integration practices?

Materials and Methods

Research Design

We designed the study as a descriptive-correlational inquiry so that two goals could be met simultaneously. We needed to describe the belief and practice profiles of Biology teachers working in Masbate's public secondary schools, and we needed to test whether the two co-vary. Neither variable could ethically or practically be manipulated. A teacher's conviction about the structure of Biology, and that teacher's habitual instructional choices, are settled long before a researcher arrives with a questionnaire. We therefore observed them as they naturally occurred (Creswell & Creswell, 2018; Fraenkel et al., 2019; Siedlecki, 2020).

Sampling Method and Respondents

The respondents were 45 public secondary Biology teachers employed by the Department of Education (DepEd) in Masbate Province at the time of data collection. Reaching them was itself part of the methodological problem. Masbate is an island province situated at the heart of the Philippine archipelago. Its public secondary schools are spread across 21 municipalities and three cities, some accessible only by outrigger boat or by a combination of bus and motorbike over unpaved roads. No central roster of specialized Biology teachers was available from the DepEd Schools Division Office, because many teachers in the province handle Biology alongside General Science, Chemistry, or Physics owing to the shortage of degree-specific science graduates. We therefore used purposive sampling, selecting only those educators who were actively teaching Biology at the secondary level in a public school in the province (Etikan et al., 2016; Tongco, 2007).

The practical route to the sample ran through three overlapping channels. The first was the official channel. After securing approval from the Schools Division Superintendent of DepEd Masbate, the research team contacted public school division superintendents and school principals by letter. The second was the Biology teachers' association within the division, which maintains informal contact lists used for cascading of principals important announcements and updates. The third was a snowball route, in which participating teachers forwarded the study invitation to colleagues in schools where our letters had not yet arrived. Nothing about this process was effortless. Several invitations reached schools days after they were sent because the local delivery route depended on ferry schedules. A few potential respondents had intermittent mobile data and could only complete the online form after traveling to the municipal center with reliable data connections. We treated these realities as the actual operational conditions of the study, not as obstacles to be abstracted away.

The final 45 participants reflect the full range of career stages available in the province. They include first-year teachers assigned to remote island barangays, mid-career Teacher IIIs who handle multiple sections, and a small group of senior educators with over fifteen years of service. All were currently teaching Biology, all were DepEd-employed, and all consented to participate. Teaching experience was not used as an exclusion criterion; we wanted precisely the comparative leverage that a mixed-experience sample provides (Borg, 2003; Pajares, 1992).

Research Instruments

We used two researcher-made instruments: the Big-Idea Coherence Belief Scale (BICoBS) and the Instructional Integration Practice Inventory (IIPI). We developed both instruments after reviewing the literature on big-idea frameworks, teacher beliefs, and instructional integration practices in science education. The items and indicators in each instrument were drawn and adapted from relevant theoretical and empirical sources so that the constructs being measured are grounded in established literature. Prior to the main data collection, we submitted both instruments to content validation by a panel of experts in Biology education and educational research. We then pilot-tested the instruments with 20 science teachers outside the study sample and assessed internal consistency reliability using Cronbach's alpha (George & Mallery, 1999; Nunnally & Bernstein, 1994).

The Big-Idea Coherence Belief Scale (BI-CoBS) is a 15-item Likert-type scale that measures the degree to which Biology teachers believe in the importance of organizing instruction around big ideas and coherent conceptual frameworks. Items were adapted from the literature on big ideas in science education (Harlen, 2010, 2017), cross-cutting concepts in the Next Generation Science Standards (NGSS Lead States, 2013), and research on teachers' pedagogical beliefs about conceptual coherence (Ambusaidi et al., 2021; Pajares, 1992). The instrument comprises three domains. Conceptual Interconnectedness measures beliefs about teaching biological concepts as an integrated network. Depth over Breadth assesses the belief that mastery of fewer, deeper concepts is preferable to broad content coverage. Cross-Cutting Concepts evaluates beliefs about the value of recurring themes such as Structure and Function, Patterns, and Systems Thinking in Biology instruction. Each item is rated on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Higher scores indicate stronger beliefs in big-idea coherence as a guiding principle for Biology instruction. The pilot test yielded a Cronbach's alpha of 0.93, which is interpreted as excellent internal consistency reliability (George & Mallery, 1999).

The Instructional Integration Practice Inventory (IIPI) is a 15-item Likert-type instrument that assesses the frequency with which Biology teachers implement instructional integration practices in their classrooms. Items were adapted from literature on thematic and integrative instruction (Drake & Burns, 2004), competency-based lesson planning frameworks used in the Philippine DepEd curriculum (DepEd, 2019), interdisciplinary science teaching (Czerniak et al., 1999), and assessment design aligned with big-idea frameworks (Wiggins & McTighe, 2005). The IIPI consists of three domains: Thematic Unit Planning, which measures the extent to which teachers design instruction around overarching big ideas and organize Most Essential Learning Competencies (MELCs) thematically; Interdisciplinary Linking, which assesses the frequency of integrating concepts from other disciplines and local contexts into Biology lessons; and Assessment Alignment, which evaluates the degree to which teachers design assessments that require students to connect and apply multiple biological concepts. Items are rated on a five-point frequency scale ranging from 1 (Never) to 5 (Always), with higher scores reflecting more frequent and comprehensive implementation of instructional integration practices. The pilot test yielded a Cronbach's alpha of 0.97, interpreted as excellent internal consistency reliability (George & Mallery, 1999).

Data Gathering Procedure

Before data collection, we secured formal permission and endorsement from the DepEd Schools Division Office of Masbate Province. A letter of informed consent was prepared and distributed to every prospective respondent. Participation was voluntary, and respondents were informed about the purpose, procedures, and confidentiality guarantees of the study. Once permissions were granted, we digitized both instruments using Google Forms. We then distributed the forms through official school email addresses, through the Biology teachers' association group chat, and through personal messaging applications, including Facebook Messenger and Telegram, which are the routine communication channels used by teachers in the province. The choice of online distribution was not primarily a matter of convenience. It was a response to the geographic dispersion of the respondents across a multi-island province where face-to-face data collection would have required weeks of travel and would have systematically excluded teachers in the most remote locations. Response windows were deliberately generous; some participants needed to travel to the municipal center to reach stable mobile data. We remained available for clarifications through direct messaging during the entire collection window. All submissions were downloaded into a password-protected spreadsheet and treated with strict confidentiality.

Ethical Considerations

Participation was entirely voluntary, and respondents could withdraw at any time without consequence. Informed consent was obtained from all participants before the administration of the instruments. We maintained strict anonymity and confidentiality throughout the study. Data were used exclusively for academic and research purposes and were stored securely to prevent unauthorized access.

Data Analysis

We used mean and standard deviation to determine the level of big-idea coherence beliefs and the level of instructional integration practices. Verbal interpretation scales followed the equal-interval approach widely used in educational research (Aburayya et al., 2019; Kinay & Ardic, 2017). The mean interval ranges and their corresponding verbal interpretations for both instruments are presented in Tables 1 and 2.

Table 1.

Mean Interval and Verbal Interpretation for the Big-Idea Coherence Belief Scale (BICoBS)

Mean Interval	Scale Description	Verbal Interpretation
4.21 to 5.00	Strongly Agree	Very High Belief in Big-Idea Coherence
3.41 to 4.20	Agree	High Belief in Big-Idea Coherence
2.61 to 3.40	Neutral	Moderate Belief in Big-Idea Coherence
1.81 to 2.60	Disagree	Low Belief in Big-Idea Coherence
1.00 to 1.80	Strongly Disagree	Very Low Belief in Big-Idea Coherence

Table 2.

Mean Interval and Verbal Interpretation for the Instructional Integration Practice Inventory (IIPI)

Mean Interval	Scale Description	Verbal Interpretation
4.21 to 5.00	Always	Very High Level of Instructional Integration
3.41 to 4.20	Often	High Level of Instructional Integration
2.61 to 3.40	Sometimes	Moderate Level of Instructional Integration
1.81 to 2.60	Rarely	Low Level of Instructional Integration
1.00 to 1.80	Never	Very Low Level of Instructional Integration

Prior to inferential testing, we ran the Shapiro-Wilk test to check whether the BICoBS and IIPI total scores, and their subgroup distributions by years of teaching experience, met the assumption of normality. The overall distributions of both the BICoBS ($W = 0.877$, $p < .001$) and IIPI ($W = 0.876$, $p < .001$) total scores significantly deviated from normality. Subgroup normality testing also revealed violations in the 4 to 9 years group for both instruments. Given these departures, we used the Kruskal-Wallis H test to test for significant differences in both big-idea coherence beliefs and instructional integration practices when respondents were grouped by years of teaching experience.

To determine the nature and strength of the relationship between big-idea coherence beliefs and instructional integration practices, we used Spearman's rank-order correlation coefficient (r_s) in place of Pearson's product-moment correlation coefficient. The Shapiro-Wilk results showed that the assumption of bivariate normality required by Pearson's r was not met for either variable. All statistical analyses were conducted at a .05 level of significance. Computations were performed in a spreadsheet-based workflow and independently verified using established computational formulas.

Results and Discussion

Demographic Profile of Respondents

Table 3 presents a consolidated summary of the respondents' distribution across the five demographic variables examined: age, gender, current teaching position, years of teaching experience in Biology or Science, and highest educational attainment. Over half of the respondents (53.33%, n = 24) were below 30 years of age. This makes the sample's teaching workforce predominantly youthful. Respondents aged 30 to 34 accounted for 26.67% (n = 12), while those between 35 and 39 comprised 15.56% (n = 7). Only two respondents (4.44%) were 40 years old and above. The mean age was 31.60 years (SD = 5.28), with a range from 24 to 51 years. This demographic trend tracks with the broader national profile of newly hired teachers in the Philippines, where most educators entering public secondary schools are relatively young, often fresh graduates or those in the early stages of their careers (Ligsanan & Peria, 2024). The young profile of Biology teachers in Masbate also mirrors findings from the Philippine PISA 2018 report (DepEd, 2019), which noted that a considerable portion of the country's science teaching force is composed of early-career professionals, particularly in provincial and island settings where teacher turnover is more frequent and recruitment is ongoing.

Table 3.
Demographic Profile of Respondents (n = 45)

Variable	Category	Frequency (f)	Percentage (%)
Age	Below 30	24	53.33
	30 to 34	12	26.67
	35 to 39	7	15.56
	40 and above	2	4.44
Gender	Female	25	55.56
	Male	20	44.44
Teaching Position	Teacher I	14	31.11
	Teacher II	4	8.89
	Teacher III	20	44.44
	Teacher IV	1	2.22
	Teacher V	1	2.22
	Teacher VI	5	11.11
Years of Experience	1 to 3 years	10	22.22
	4 to 9 years	24	53.33
	10 to 14 years	9	20.00
	15 years and above	2	4.44
Educational Attainment	Bachelor's Degree	13	28.89
	Master's Degree / With Master's Units	27	60.00
	Doctoral Degree / With Doctoral Units	5	11.11
Total		**45**	**100.00**

Slightly more than half of the respondents were female (55.56%, n = 25), while 44.44% (n = 20) were male. This female predominance is consistent with the general feminization of the teaching profession in the Philippines, particularly at the secondary level, where female teachers have historically outnumbered their male counterparts (DepEd, 2019). This pattern has been observed across Southeast Asian educational systems and reflects broader sociocultural dynamics that position teaching as a traditionally feminine profession.

Regarding teaching position, Teacher III was the most common rank among respondents (44.44%, n = 20), followed by Teacher I (31.11%, n = 14) and Teacher VI (11.11%, n = 5). The remaining positions, Teacher II, Teacher IV, and Teacher V, were held by fewer respondents, totaling 13.33% collectively. The predominance of Teacher III suggests that a significant share of Biology teachers in Masbate have reached early-to-mid career advancement within the DepEd salary grade system, indicating some professional stability. The 31.11% share of Teacher I respondents corroborates the age data and confirms the early-career composition of the province's Biology teaching force.

For years of teaching experience, the largest proportion of respondents had been in service for 4 to 9 years (53.33%, n = 24), followed by 1 to 3 years (22.22%, n = 10), 10 to 14 years (20.00%, n = 9), and 15 years and above (4.44%, n = 2). The distribution reflects a workforce that is, on balance, relatively early in its career trajectory, a pattern with implications for how beliefs and practices are shaped by professional context, as discussed in subsequent sections.

Most respondents held a Master's degree or had earned graduate-level units (60.00%, n = 27). Another 28.89% (n = 13) held only a Bachelor's degree, and 11.11% (n = 5) had attained or were pursuing a Doctoral degree. The relatively high proportion of postgraduate attainment is notable. It suggests that Biology teachers in Masbate invest in their own professional and academic development despite the province's geographic and resource constraints. Research consistently demonstrates that advanced academic preparation is associated with stronger pedagogical content knowledge and a greater orientation toward reform-based instructional practices (Mapulanga et al., 2022).

Level of Belief in Big-Idea Coherence Among Biology Teachers

The second research question sought to determine the level of big-idea coherence beliefs among the respondents as measured by the BICoBS. The instrument comprises 15 items distributed across three domains: Conceptual Interconnectedness (Domain 1), Depth over Breadth (Domain 2), and Cross-Cutting Concepts (Domain 3). Table 4 summarizes the mean scores and verbal interpretations for each domain and for the overall scale.

Table 4.

Mean Scores and Verbal Interpretations for the Big-Idea Coherence Belief Scale (BICoBS)

Domain	Mean	SD	Verbal Interpretation
Domain 1: Conceptual Interconnectedness	4.71	0.34	Very High Belief
Domain 2: Depth over Breadth	4.62	0.43	Very High Belief
Domain 3: Cross-Cutting Concepts	4.74	0.35	Very High Belief
Overall Mean Score	**4.69**	**0.31**	**Very High Belief**

The overall mean score for the BICoBS was 4.69 (SD = 0.31), interpreted as Very High Belief in Big-Idea Coherence. All three domains landed within the Very High Belief range. Domain 3 (Cross-Cutting Concepts) obtained the highest domain mean at M = 4.74 (SD = 0.35), followed by Domain 1 (Conceptual Interconnectedness) at M = 4.71 (SD = 0.34), and Domain 2 (Depth over Breadth) at M = 4.62 (SD = 0.43). The Biology teachers in Masbate strongly believe that biological concepts should be taught as an interconnected network organized around overarching themes. They also endorse cross-cutting ideas such as Structure and Function, Patterns, and Systems Thinking as essential tools for science instruction. They value depth of conceptual understanding over broad content coverage.

At the item level, the highest-rated item within Domain 1 was the belief that understanding the relationship between systems is more important than memorizing terms (M = 4.91, SD = 0.29). The belief in a spiraling approach to connecting old and new concepts received a comparatively lower rating (M = 4.31, SD = 0.85). Within Domain 2, the strongest item was the belief that students' ability to explain the 'why' of a concept outweighs their ability to define it (M = 4.80, SD = 0.50). The belief in mastering a few Big Ideas in depth rather than covering every curriculum detail yielded the lowest mean within that domain (M = 4.29, SD = 0.97), though still within the Very High Belief range. Within Domain 3, the beliefs that Structure and Function, and Systems and System Models, are vital analytical tools for biological systems both garnered means of 4.82 (SD = 0.39).

These results are consistent with emerging findings from science education research in diverse international contexts. Bravo Gonzalez and Reiss (2023) reported that Chilean science teachers held strongly positive views about the value of Big Ideas in science teaching, recognizing them as powerful organizers for conceptual coherence and curriculum alignment. Teachers who had been explicitly introduced to Big Ideas frameworks tended to describe these frameworks as the natural way to teach science, a sentiment mirrored in the present sample's strong endorsement of conceptual interconnectedness and cross-cutting themes. Ambusaidi et al. (2021) found that Biology teachers who hold constructivist and integrative pedagogical beliefs tend to express high agreement with the value of organizing instruction around broad, unifying ideas rather than isolated topics.

The strong endorsement of cross-cutting concepts finds theoretical support in the NGSS framework (NGSS Lead States, 2013), which identifies recurring themes such as Patterns, Cause and Effect, Energy and Matter, and Systems Thinking as disciplinary tools that cut across science content areas. Harlen (2010, 2017) similarly argued that such recurring ideas act as intellectual bridges, enabling students to transfer understanding across seemingly disparate biological phenomena. The fact that Biology teachers in Masbate strongly endorse these ideas suggests alignment between their conceptual beliefs and the epistemological foundations of contemporary science education reform. Read through a social psychology lens, this alignment amounts to a professional group whose attitudes and beliefs have converged on an integrative vision of Biology teaching, even in the absence of consistent face-to-face professional development.

The slightly lower scores in Domain 2, particularly on items related to depth over breadth, may reflect a tension inherent in the Philippine K to 12 curriculum, which requires teachers to address a broad range of Most Essential Learning Competencies (MELCs) within constrained instructional timeframes (DepEd, 2019). Teachers espouse the importance of deep conceptual understanding, yet perceived pressure to cover curriculum content seems to moderate their confidence in applying depth-over-breadth principles. This tension resonates with Barrot (2021), who noted that constructive alignment between curriculum design, instructional delivery, and teacher orientations remains a persistent challenge in the Philippine educational context. Still, all three domains yielded very high mean scores. The respondents hold a coherent and positive conceptual framework for Biology instruction.

Level of Instructional Integration Practices

The third research question examined the extent to which the respondents implemented instructional integration practices in their classrooms, as measured by the IIPI. The IIPI consists of 15 items across three domains: Thematic Unit Planning (Domain 1), Interdisciplinary Linking (Domain 2), and Assessment Alignment (Domain 3). Table 5 presents the mean scores and verbal interpretations.

Table 5.
Mean Scores and Verbal Interpretations for the Instructional Integration Practice Inventory (IIPI)

Domain	Mean	SD	Verbal Interpretation
Domain 1: Thematic Unit Planning	4.33	0.63	Very High Level
Domain 2: Interdisciplinary Linking	4.49	0.57	Very High Level
Domain 3: Assessment Alignment	4.51	0.53	Very High Level
Overall Mean Score	**4.44**	**0.52**	**Very High Level**

The overall IIPI mean was 4.44 (SD = 0.52), interpreted as Very High Level of Instructional Integration. All three domains yielded means within the same interpretive category. Domain 3 (Assessment Alignment) obtained the highest mean at M = 4.51 (SD = 0.53), followed by Domain 2 (Interdisciplinary Linking) at M = 4.49 (SD = 0.57), and Domain 1 (Thematic Unit Planning) at M = 4.33 (SD = 0.63). The ordering suggests that the respondents engage somewhat more consistently in integration-aligned assessment practices and interdisciplinary connections than in the structural, unit-level planning dimension.

At the item level, the highest-rated item across the entire IIPI was the use of rubrics that explicitly reward students for demonstrating a coherent understanding of systems (M = 4.78, SD = 0.42), followed by the practice of incorporating local environmental issues to show the real-world integration of biological concepts (M = 4.73, SD = 0.58) and the use of local ecosystems or agricultural examples to illustrate global biological principles (M = 4.67, SD = 0.56). The respondents are especially inclined toward embedding local and environmental contexts into their instruction and assessments. This practice is consistent with the localization imperative of the Philippine DepEd curriculum (DepEd, 2019) and with Harlen's (2017) claim that big-idea-centered instruction is most effective when anchored in learners' lived experiences.

The lowest-rated item within Domain 1 was the practice of designing Daily Lesson Logs (DLL) around an overarching Big Idea rather than a daily topic (M = 4.07, SD = 0.78). It was also the lowest-rated item across the entire instrument. The grouping of related MELCs into cohesive thematic units received a mean of 4.20 (SD = 0.99). Both means still fall within the High Level of Instructional Integration range, but they are noticeably lower than the other items. This pattern may reflect the structural demands of daily lesson planning in the Philippine DepEd system, which requires teachers to organize instruction around competency-based objectives. This requirement can constrain the freedom to reframe individual lessons around broader thematic structures. Ligsanan and Peria (2024) have similarly noted that Filipino science teachers face challenges in meaningful curricular decision-making, particularly in balancing compliance with instructional mandates against more autonomous, coherence-oriented planning.

The strong performance on Domain 2 (Interdisciplinary Linking) is worth emphasizing. Teachers reported frequently integrating concepts from Chemistry and Physics (M = 4.42, SD = 0.69), using local ecological examples (M = 4.67), and incorporating local environmental issues (M = 4.73). These patterns are consistent with the interdisciplinary framework advocated by Czerniak et al. (1999) and more recently supported by Mapulanga et al. (2024), who emphasized that effective Biology teaching draws on cross-disciplinary knowledge to contextualize and deepen understanding. The slightly lower mean for collaborative planning with other science teachers to ensure shared Big Ideas across subjects (M = 4.27, SD = 0.96) suggests that individual integration is well-established, while collaborative and systemic integration across the curriculum remains more variable.

The very high level of implementation observed in this study stands in partial contrast to findings from international research. Mapulanga et al. (2024) found that Zambian secondary Biology teachers could articulate the importance of conceptual connections, yet their actual integration of pedagogical content knowledge components in lessons remained fragmented. Bravo Gonzalez and Reiss (2023) found considerable variation in Chilean teachers' implementation of Big Ideas-centered instruction depending on their familiarity with formal frameworks and institutional support. The elevated IIPI scores in the present study may partly reflect the relatively high level of educational attainment among respondents and the growing alignment of teacher preparation with the MATATAG curriculum's integrative philosophy (DepEd, 2023). The MATATAG curriculum is, in policy terms, a lever. It changes what teachers are asked to plan, what kinds of competencies are expected to appear in assessment, and which theoretical language, big ideas, cross-cutting concepts, conceptual coherence, is now considered the official vocabulary of the discipline. When a national policy defines that vocabulary, the professional group that implements it eventually begins to use it, and eventually to mean it.

A content analysis of five lesson plans submitted by Biology and Science teachers provided documentary evidence that corroborates and contextualizes the self-report survey findings. The analyzed plans covered Mendelian genetics, taxonomic classification, levels of biological organization, motion graphs, and biological diversity. We examined them for evidence across the three IIPI domains. In Thematic Unit Planning, four of the five lesson plans explicitly foregrounded a Big Idea or Key Idea/Stem as the organizing anchor of the lesson. One teacher structured an entire lesson on Punnett squares around the explanatory stem, "Given the genotypes of any two parents, we can predict the genotypes of the gametes produced during meiosis," orienting all instructional activities and assessments toward this unifying principle. Another lesson on Levels of Biological Organization was built around the explicit conceptual conclusion that life is an organized and unified system, with concept development, group tasks, and formative items all oriented toward demonstrating that idea rather than enumerating individual levels in isolation. These documentary findings lend validity to the survey data on thematic unit planning. They also help explain the relatively lower domain mean (M = 4.33). Even where thematic framing was present, some plans retained a competency-level organizational structure, reflecting the structural tension between big-idea coherence and compliance-driven daily planning noted in prior Philippine curriculum research (Ligsanan & Peria, 2024).

Interdisciplinary linking was the most consistently and explicitly documented dimension in the analyzed lesson plans, a finding that aligns with its strong domain mean of M = 4.49. Multiple teachers systematically connected their lessons to the Sustainable Development Goals, providing substantive explanations of how biological concepts relate to land biodiversity, marine conservation, public health, and climate action. A lesson on taxonomic classification linked the six-kingdom system to the conservation of both terrestrial and aquatic ecosystems. A lesson on levels of biological organization connected the biosphere level to Earth Science content by explaining how living systems depend on the atmosphere, hydrosphere, and geosphere. One teacher cited specific Mathematics competency codes when integrating ratio and fraction skills into the calculation of offspring genotype and phenotype ratios, an example of deliberate, systematic cross-curricular planning rather than incidental reference. These patterns confirm that individual interdisciplinary integration is a well-established and documentable practice among the sampled teachers. They also corroborate the survey finding that collaborative, systemic integration across subjects remains comparatively less frequent (M = 4.27, SD = 0.96). In Assessment Alignment, the lesson plan analysis revealed that the most sophisticated examples of big-idea-centered assessment involved tasks requiring students to apply conceptual frameworks rather than retrieve factual content. One genetics lesson required groups to reconstruct parent genotypes from observed offspring ratios, a task demanding genuine application of Mendelian inheritance principles. Another lesson employed a Cause-and-Effect Chain activity in which students traced the systemic consequences of a disruption at one level of biological organization upward to the biosphere, operationalizing systems thinking as an assessable student behavior. These specific artifacts confirm that at least some teachers design assessments that align with the highest-rated IIPI items, particularly the use of rubrics rewarding coherent systems understanding (M = 4.78). Sophisticated assessment design appears to coexist with strong thematic and interdisciplinary planning practices. Drawn together, the lesson plan content analysis substantiates the survey findings and provides a richer account of how big-idea coherence is operationalized across Biology and Science topics in the Masbate context.

Differences in Big-Idea Coherence Beliefs by Years of Teaching Experience

The fourth research question examined whether significant differences existed in Biology teachers' big-idea coherence beliefs when respondents were grouped by years of teaching experience. The Shapiro-Wilk test revealed a non-normal distribution for the BICoBS Total scores (W = 0.877, p < .001), and subgroup normality tests indicated violations for the 4 to 9 years group (W = 0.889, p = .012). We therefore used the Kruskal-Wallis H test as the appropriate nonparametric alternative to one-way ANOVA. Table 6 summarizes the results.

Table 6.

Kruskal-Wallis Test Results Comparing Big-Idea Coherence Beliefs by Years of Teaching Experience

Experience Group	n	Mean	SD	Mean Rank
1 to 3 years	10	4.78	0.28	25.45
4 to 9 years	24	4.61	0.34	21.38
10 to 14 years	9	4.81	0.17	24.72
15 years and above	2	4.63	0.18	20.50
Kruskal-Wallis H		**2.27**		
p-value		**.519**		

Note. alpha = .05. Decision: Fail to reject H_0. The differences among groups are not statistically significant.

The Kruskal-Wallis test yielded a non-significant result (H = 2.27, p = .519). There is no statistically significant difference in big-idea coherence beliefs among Biology teachers across experience levels. Descriptive differences are visible. Teachers in the 10 to 14 years group obtained the highest mean BICoBS score (M = 4.81, SD = 0.17), and those in the 4 to 9 years group obtained the lowest (M = 4.61, SD = 0.34). None of these differences reached statistical significance at the .05 alpha level.

This finding aligns with the longitudinal research by Luft et al. (2011), who followed 98 secondary science teachers over their first two years in the profession and reported no significant change in teachers' beliefs over time, even as their pedagogical content knowledge and instructional practices evolved. The authors attributed the stability of beliefs to their deep, early entrenchment, a conclusion that supports Pajares' (1992) argument that teacher beliefs are highly resistant to change because they form during pre-professional experiences and function as implicit filters rather than consciously examined frameworks. In the present study, the uniformity of beliefs across experience groups points to a shared professional orientation toward big-idea coherence within the Biology teaching group in Masbate, regardless of time in service. This uniformity is, in sociological terms, evidence of a pedagogical cultural shift in process. A province whose teachers once inherited a transmissionist view of Biology now houses a professional group in which coherence-oriented thinking has become the default, early-career and late-career alike.

Gore et al. (2024) analyzed 990 lessons taught by 512 teachers in New South Wales and similarly found no significant differences in pedagogical quality across the experience range. They challenged the assumption that more experienced teachers are necessarily more effective or pedagogically distinct from their junior counterparts. In the Philippine context, Oris and Caballes (2024) reported comparable findings among Filipino teachers in an exchange program in the United States, noting that teaching experience did not significantly advantage performance in new instructional contexts, even among seasoned professionals. The absence of experience-related differences in big-idea coherence beliefs observed in the present study reflects a pattern documented across diverse educational settings. The uniformly high beliefs across all experience groups likely reflect the shared influence of teacher preparation programs, the MATATAG curriculum's integrative philosophy, and the shared professional culture among Biology teachers in Masbate's schools.

Differences in Instructional Integration Practices by Years of Teaching Experience

The fifth research question examined whether significant differences existed in the respondents' instructional integration practices when grouped by years of teaching experience. We applied the same nonparametric approach used for the BICoBS analysis. The Kruskal-Wallis H test was appropriate because the Shapiro-Wilk test had detected non-normal distributions within experience groups. Table 7 presents the results.

Table 7.

Kruskal-Wallis Test Results Comparing Instructional Integration Practices by Years of Teaching Experience

Experience Group	n	Mean	SD	Mean Rank
1 to 3 years	10	4.37	0.61	22.45
4 to 9 years	24	4.48	0.51	23.40
10 to 14 years	9	4.49	0.51	23.56
15 years and above	2	4.17	0.41	18.25
Kruskal-Wallis H		**0.51**		
p-value		**.916**		

Note. alpha = .05. Decision: Fail to reject H_0. The differences among groups are not statistically significant.

The Kruskal-Wallis test yielded a non-significant result (H = 0.51, p = .916). There is no statistically significant difference in instructional integration practices among Biology teachers across experience levels. IIPI means ranged narrowly from 4.17 (15 years and above) to 4.49 (10 to 14 years), with mean ranks similarly clustered. The level of instructional integration practices remains largely consistent across the career continuum of Biology teachers in the sampled schools.

This result parallels the BICoBS finding and underlines a pattern of cross-experience consistency in both teachers' pedagogical orientations and their reported classroom behaviors. The stability of instructional integration practices across experience groups may be partly explained by the shared curriculum context. All respondents, regardless of career stage, work within the same MATATAG and K to 12 curriculum frameworks, which promote spiraling, integrative, and competency-based approaches (DepEd, 2019, 2023). This shared structure functions as a common institutional press that shapes instructional practices more powerfully than individual experience trajectories. In policy-analytic terms, the MATATAG curriculum performs exactly the kind of leverage a well-designed reform instrument is supposed to perform. It pulls novice and veteran teachers toward the same integrative vocabulary, the same thematic framing, the same cross-disciplinary reflex. In the context of the study, experience ceases to be the dominant sorting variable.

This finding also resonates with the broader literature on teacher experience and instructional practice. Luft et al. (2011) noted that new teachers did show some growth in instructional practices during their early years, but these changes were gradual and subject to administrative and contextual constraints. Experience alone is neither a prerequisite for nor a predictor of integrative instructional behavior among Biology teachers in Masbate. Early-career and veteran teachers appear to be equally engaged in practices that reflect conceptual coherence, thematic planning, interdisciplinary linking, and integration-focused assessment. This result speaks to the capacity of teacher preparation programs and curricular policy to shape integrative practices across the full arc of a teaching career.

Relationship Between Big-Idea Coherence Beliefs and Instructional Integration Practices

The sixth and central research question examined whether a significant relationship existed between the respondents' big-idea coherence beliefs (BICoBS) and their instructional integration practices (IIPI). The Shapiro-Wilk test indicated significant departures from normality for both variables (BICoBS: W = 0.877, p < .001; IIPI: W = 0.876, p < .001). We therefore used Spearman's rank-order correlation coefficient (r_s) as the nonparametric measure of association. Table 8 presents the results of the correlation analysis at both the overall and domain levels.

Table 8.
Spearman's Rank-Order Correlation Results Between Big-Idea Coherence Beliefs and Instructional Integration Practices

Variables	r_s	p-value	Decision
Big-Idea Coherence Beliefs x Instructional Integration Practices	.550	.000	Significant
D1: Conceptual Interconnectedness x D1: Thematic Unit Planning	.428	.003	Significant
D2: Depth over Breadth x D2: Interdisciplinary Linking	.404	.006	Significant
D3: Cross-Cutting Concepts x D3: Assessment Alignment	.418	.004	Significant

Note. alpha = .05. r_s = Spearman's rank-order correlation coefficient. All correlations are statistically significant.

The Spearman correlation analysis revealed a statistically significant moderate positive relationship between the overall big-idea coherence beliefs and instructional integration practices scores (r_s = .550, p < .001). Biology teachers who hold stronger beliefs in big-idea coherence, teachers who more firmly believe in teaching Biology as an interconnected network of ideas organized around overarching themes, also report significantly more frequent and comprehensive implementation of instructional integration practices in their classrooms. The moderate effect size is practically meaningful, particularly given the already uniformly high scores on both instruments, which tend to attenuate correlation coefficients through restricted variance.

At the domain level, all three cross-domain correlations were statistically significant. Conceptual Interconnectedness beliefs were significantly associated with Thematic Unit Planning practices (r_s = .428, p = .003). Depth over Breadth beliefs were significantly associated with Interdisciplinary Linking practices (r_s = .404, p = .006). Cross-Cutting Concepts beliefs were significantly associated with Assessment Alignment practices (r_s = .418, p = .004). These domain-level associations indicate that the belief-practice relationship is not concentrated in any single subdimension but is distributed coherently across the conceptual structure of both instruments.

The significant positive correlation provides empirical support for Pajares' (1992) foundational proposition that teacher beliefs serve as powerful filters on instructional decision-making. In the Biology education context, teachers who value the integration of biological concepts around big ideas are more likely to translate those values into observable classroom behaviors, including thematic lesson planning, cross-disciplinary connections, and assessment tasks that demand conceptual synthesis. Alignment between espoused beliefs and instructional behavior is not guaranteed. Ambusaidi et al. (2021) documented a persistent gap between the progressive pedagogical beliefs of Omani Biology teachers and the teacher-centered, content-focused instruction that characterized their actual practice. The present study's finding of a significant positive correlation is, against that backdrop, an encouraging result. In the Masbate context, teachers' endorsement of big-idea coherence is reflected in their self-reported instructional behaviors.

This finding also converges with Bravo Gonzalez and Reiss (2023), who reported that teachers who had more thoroughly internalized the Big Ideas framework tended to implement it more deliberately and consistently, particularly in making explicit connections across lessons and designing coherent instructional sequences. Cess-Newsome (1999) theorized that Biology teachers' perceptions of subject matter structure, whether they conceptualize Biology as a set of discrete topics or as an integrated network, are closely tied to their classroom practices. The present study extends this claim into the contemporary Philippine context and provides quantitative evidence that such cognitive-behavioral alignment exists among in-service secondary Biology teachers in a provincial setting.

From a pedagogical content knowledge perspective (Shulman, 1987), the correlation suggests that teachers who hold well-articulated beliefs about the epistemic structure of Biology, anchored in big ideas and cross-cutting themes, are better positioned to enact integrative instruction. Mapulanga et al. (2022) demonstrated that teachers with stronger enacted pedagogical content knowledge in Biology produced more coherent learning experiences for their students. The link between coherence-oriented beliefs and integration-oriented practices observed here suggests a parallel orientation: belief in conceptual interconnectedness appears to manifest in instructional behaviors that make those connections visible and teachable for students.

The significant moderate correlation, however, must still be read with appropriate caution. Both instruments relied on self-report data, which are susceptible to social desirability bias. The restricted variance at the upper end of both scales may have suppressed the true magnitude of the association. We recommend therefore, that future research using classroom observation, expanded lesson plan analysis, and student outcome data would provide a more ecologically valid and triangulated understanding of how Biology teachers' big-idea coherence beliefs translate into actual instructional integration practices in the Masbate context and beyond. Nevertheless, the present findings constitute a meaningful contribution to the underrepresented body of empirical literature on Biology education in provincial Philippine contexts.

Conclusion

We set out to examine whether Biology teachers in Masbate, working in an island province at the center of the Philippine archipelago with limited laboratory equipment and uneven professional development, actually teach Biology the way they believe it should be taught; within this sample, we found that they do. Theoretically, this refines Pajares' belief-filter model by showing, within Philippine provincial conditions, that coherence-oriented beliefs track with integrative classroom behavior rather than collapsing into the familiar belief-practice gap. For policy, the MATATAG Science Curriculum is functioning as a real lever, pulling early-career and veteran teachers toward a shared integrative vocabulary. The evidence is bounded by self-report and by a single province; given our measures, the convergence of beliefs and practices cannot by itself establish causal direction. Within these constraints, a targeted next step is a classroom-observation study, paired with extended lesson-plan audits, across two or more island provinces to test whether documented practice matches the self-reported pattern.

Recommendations

The findings point to a clear and actionable agenda, one organized not around what is missing but around what the data show is already working and where the systems around it need to catch up. For DepEd Masbate school administrators, the priority is to close the gap in thematic unit planning through collaborative lesson study, curriculum mapping workshops, and protected interdisciplinary planning time, so that teachers' coherence-oriented beliefs take documentary form in the Daily Lesson Log. For teacher educators and pre-service institutions, because experience does not differentiate either beliefs or practices, the decisive investment sits in initial formation; programs should engage pre-service teachers directly with big-idea frameworks, curriculum integration strategies, and the epistemic structure of Biology. For curriculum developers and policymakers, the MATATAG curriculum already embeds an integrative philosophy, what it still needs are planning templates and guides that make the link between individual MELCs and overarching Big Ideas structurally evident, so coherence is achieved through the planning system rather than in spite of it. For future researchers, classroom-observation protocols, think-aloud lesson-planning studies, and document audits extended to other island provinces would help test whether the observed pattern holds more broadly and enlighten how coherence-oriented beliefs translate into real-time planning decisions.

Acknowledgement

The authors express their heartfelt gratitude to the Schools Division Superintendent of DepEd Masbate for granting permission to conduct this study. They also extend their sincere appreciation to the public secondary Biology teachers in Masbate for their invaluable insights and contributions, which greatly facilitated the successful completion of this research.

Author Contribution Statements

Cajurao, E.: Conceptualization, Methodology, Writing-Original draft preparation, Data curation, Investigation, Validation. **Mortel, J. C.**: Conceptualization, Methodology, Writing-Original draft preparation. **Padre, E.**: Conceptualization, Validation, Writing, Reviewing and Editing. **Ang, R.**: Writing, Reviewing and Editing.

AI Use Disclosure

During the preparation of this work, the authors used Gemini 3.0 for data analysis and visualization and Claude 4.6 for grammar improvement and readability. After using these AI tools, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

References

Aburayya, A., Alawadhi, D., and Taryam, M. (2019). A conceptual framework for implementing TQM in the primary healthcare centers and examining its impact on patient satisfaction. *International Journal of Advanced Research, 7*(3), 1047-1065. https://dx.doi.org/10.21474/IJAR01/8735

Ambusaidi, I., Badiali, B., and Alkharousi, K. (2021). Examining how biology teachers' pedagogical beliefs shape the implementation of the Omani reform-oriented curriculum. *Athens Journal of Education, 8*(1), 73-113.

Antipolo, A. M. R., and Danilo Jr, V. (2021). Filipino prospective teachers' experiences in teaching in K12 science curriculum: A cross-sectional research. JPBI *(Jurnal Pendidikan Biologi Indonesia), 7*(1), 1-10.

Barrot, J. S. (2023). K to 12 curriculum reform in the Philippines: Towards making students future ready. *Asia Pacific Journal of Education, 43*(4), 1193-1207. https://doi.org/10.1080/02188791.2021.1973959

Borg, S. (2003). Teacher cognition in language teaching: A review of research on what language teachers think, know, believe, and do. Language Teaching, 36(2), 81-109. https://doi.org/10.1017/S0261444803001903

Bravo Gonzalez, P., and Reiss, M. J. (2023). Science teachers' views of creating and teaching Big Ideas of science education: Experiences from Chile. *Research in Science and Technological Education, 41*(2), 523-543. https://doi.org/10.1080/02635143.2021.1919868

Brownell, S. E., and Tanner, K. D. (2012). Barriers to faculty pedagogical change: Lack of training, time, incentives, and tensions with professional identity. *CBE Life Sciences Education, 11*(4), 339-346. https://doi.org/10.1187/cbe.12-09-0163

Cess-Newsome, J. (1999). Secondary teachers' knowledge and beliefs about subject matter and their impact on instruction. In Examining pedagogical content knowledge: The construct and its implications for science education (pp. 51-94). Springer Netherlands.

Chalmers, C., Carter, M., Cooper, T., and Nason, R. (2017). Implementing big ideas to advance the teaching and learning of science, technology, engineering, and mathematics (STEM). *International Journal of Science and Mathematics Education,* *15*(1), 25-43. https://doi.org/10.1007/s10763-017-9799-1

Cleveland, L. M., Olimpo, J. T., and DeChenne-Peters, S. E. (2017). Investigating the relationship between instructors' use of active-learning strategies and students' conceptual understanding and affective changes in introductory biology: A comparison of two active-learning environments. CBE Life Sciences Education, 16(2), ar19. https://doi.org/10.1187/cbe.16-06-0181

Creswell, J. W., and Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.

Creswell, J. W., and Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE Publications.

Czerniak, C. M., Weber Jr, W. B., Sandmann, A., and Ahern, J. (1999). A literature review of science and mathematics integration. *School Science and Mathematics, 99*(8), 421-430.

Department of Education. (2019). PISA 2018 national report of the Philippines. DepEd. https://www.deped.gov.ph/wp-content/uploads/2019/12/PISA-2018-Philippine-National-Report.pdf

Department of Education. (2019). K to 12 Basic Education Curriculum: Science curriculum guide. DepEd.

Department of Education. (2023). MATATAG Science Curriculum Guide (Grades 4 and 7). DepEd. https://www.deped.gov.ph/matatag-curriculum/matatag-science-cg-grade-4-and-7/

Drake, S. M., and Burns, R. C. (2004). Meeting standards through integrated curriculum. Association for Supervision and Curriculum Development.

Etikan, I., Musa, S. A., and Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. American *Journal of Theoretical and Applied Statistics, 5*(1), 1-4. https://doi.org/10.11648/j.ajtas.20160501.11

Fraenkel, J. R., Wallen, N. E., and Hyun, H. H. (2019). How to design and evaluate research in education (10th ed.). McGraw-Hill Education.

George, D., and Mallery, P. (1999). SPSS for Windows step by step: A simple guide and reference (4th ed.). Allyn and Bacon.

Gore, J., Rosser, B., Jaremus, F., Miller, A., and Harris, J. (2024). Fresh evidence on the relationship between years of experience and teaching quality. *The Australian Educational Researcher, 51*(2), 547-570. https://doi.org/10.1007/s13384-023-00612-0

Harlen, W. (Ed.). (2010). Principles and big ideas of science education. Association for Science Education.

Harlen, W. (2017). Working towards big ideas: Implications for the curriculum, pedagogy and assessment. *Profession, 18*, 19.

Kinay, I., and Ardic, T. (2017). Investigating teacher candidates' beliefs about standardized testing. *Universal Journal of Educational Research, 5*(12), 2286-2293. https://doi.org/10.13189/ujer.2017.051219

Ligsanan, L. S., and Peria, J. N. (2024). Navigating the intersection: A phenomenological exploration of physical science teachers teaching biology. *The Quest: Journal of Multidisciplinary Research and Development, 3*(1).

Luft, J. A., Firestone, J. B., Wong, S. S., Ortega, I., Adams, K., and Bang, E. (2011). Beginning secondary science teacher induction: A two-year mixed methods study. *Journal of Research in Science Teaching, 48*(10), 1199-1224. https://doi.org/10.1002/tea.20444

Mapulanga, T., Ameyaw, Y., Nshogoza, G., and Bwalya, A. (2024). Integration of topic-specific pedagogical content knowledge components in secondary school science teachers' reflections on biology lessons. *Discover Education, 3*(1), 17. https://doi.org/10.1007/s44217-024-00104-y

Mapulanga, T., Nshogoza, G., and Yaw, A. (2022). Teachers' perceived enacted pedagogical content knowledge in biology at selected secondary schools in Lusaka. *International Journal of Learning, Teaching and Educational Research, 21*(10), 418-

435. https://doi.org/10.26803/ijlter.21.10.23

National Research Council. (2007). *Taking science to school: Learning and teaching science in grades K-8*. National Academies Press. https://doi.org/10.17226/11625

NGSS Lead States. (2013). Next generation science standards: For states, by states. National Academies Press.

Nunnally, J. C., and Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill.

Oris, R. S., and Caballes, D. G. (2024). The professional performance of Filipino teachers under teacher exchange program of United States during the academic year 2022-2023. Science International (Lahore), 36(2), 143-148.

Pajares, M. F. (1992). Teachers' beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research, 62*(3), 307-332. https://doi.org/10.3102/00346543062003307

Saad, R., and BouJaoude, S. (2012). The relationship between teachers' knowledge and beliefs about science and inquiry and their classroom practices. *Eurasia Journal of Mathematics, Science and Technology Education, 8*(2), 113-128. https://doi.org/10.12973/ejmste/75704

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-23. https://doi.org/10.17763/haer.57.1.j463w79r56455411

Sideridis, A. S. (2022). Next Generation Science Standards: Teachers' perceptions of their professional development and classroom implementation (Publication No. 29068018) [Doctoral dissertation, Walden University]. ScholarWorks. https://scholarworks.waldenu.edu/dissertations/12542/

Siedlecki, S. L. (2020). Understanding descriptive research designs and methods. *Clinical Nurse Specialist, 34*(1), 8-12. https://doi.org/10.1097/NUR.0000000000000493

Tiu, J. B., and Rabago, J. K. M. (2025). Strategies, competence, and challenges of teachers in teaching controversial issues: A qualitative study from northern Philippines. *International Journal of Research and Innovation in Social Science, 9*(9), 2889-2894. https://doi.org/10.47772/IJRISS.2025.909000247

Tongco, M. D. C. (2007). Purposive sampling as a tool for informant selection. *Ethnobotany Research and Applications, 5*, 147-158. https://doi.org/10.17348/era.5.0.147-158

Twyman, J. S., and Hockman, A. (2021). You have the big idea, concept, and some examples. Now what? Behavior Analysis in Practice, 14(3), 802-815. https://doi.org/10.1007/s40617-021-00638-9

Wiggins, G., and McTighe, J. (2005). Understanding by design (2nd ed.). Association for Supervision and Curriculum Development.

Zaitsev, I. V. (2021). Conjunctional concepts: The conceptual teaching technique in biology classes. *Journal of Microbiology and Biology Education, 22*(3), e00168-21. https://doi.org/10.1128/jmbe.00168-21