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Competence Of Out-Of-Field Science Teachers: Basis for A Professional Development Program

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Abstract — This study investigates the competence of out-of-field science teachers and identifies the factors that influence their professional development. The research focused on 80 teachers from various schools, assessing their academic qualifications, teaching experience, participation in science-related training, and the training they have attended. Data were gathered through surveys, and the teachers' competencies were evaluated across key dimensions, including adaptability, promoting critical thinking, classroom management, and the use of science-specific resources. Results indicated that while out-of-field science teachers demonstrated high competence in areas such as adaptability and promoting critical thinking, they showed lower competence in science content knowledge and the integration of technology. Furthermore, participation in science-related training was found to have a significant positive relationship with their overall level of competence. At the same time, factors such as academic qualifications and years of teaching experience were not significantly related to competence. Based on these findings, the study proposes a comprehensive professional development program designed to enhance content knowledge, technological skills, and collaborative teaching practices among out-of-field science teachers. The program emphasizes the importance of continuous training and targeted support to improve teaching quality and ensure effective science education.

I. Introduction

Science education plays a crucial role in developing students' critical thinking, problem-solving skills, and understanding of the natural world. However, the effectiveness of science instruction heavily depends on the competence of the teachers delivering the content. In many educational systems, including those in the Philippines, there is a growing concern about out-of-field teaching, where teachers are assigned to teach subjects outside their area of expertise. This issue is particularly prevalent in the Schools Division of Mabalacat City, where numerous Grade 7 science teachers lack formal training in science education, leading to suboptimal student outcomes.

The phenomenon of out-of-field teaching is not unique to the Philippines. In the United States, the National Center for Education Statistics (2018) reported that a significant percentage of middle school science teachers are teaching without a major or certification in science. Similarly, a study by Ingersoll (2019) highlighted that out-of-field teaching contributes to lower student achievement and increased teacher turnover. In Australia, Weldon (2016) emphasized the negative impact of out-of-field teaching on student engagement and comprehension in science subjects. The

Organisation for Economic Co-operation and Development (OECD, 2017) also pointed out that countries with higher proportions of out-of-field teachers tend to have wider achievement gaps in science education.

Smith and Ingersoll (2015) conducted a comprehensive study in the United States that highlighted the detrimental effects of teaching out of field on student performance. Their research revealed that students taught by teachers who lacked a background in science scored significantly lower on standardized science tests compared to their peers whom teachers with a science background taught. This finding underscores the importance of subject matter expertise in delivering effective science education, as out-of-field teachers often struggle with the content knowledge necessary to facilitate deep student understanding and engagement in scientific concepts.

In the United Kingdom, Hobbs (2016) explored the broader implications of out-of-field teaching beyond academic performance. Her study found that out-of-field science teachers often faced significant challenges in classroom management and instructional strategies. These teachers were less confident in their ability to manage classrooms effectively and implement engaging, pedagogically sound instructional methods. As a result, there was a noticeable decrease in student engagement and participation in science classes, which can further exacerbate the difficulties in learning complex scientific concepts.

Darling-Hammond et al. (2018) in Canada provided evidence that targeted professional development could mitigate some of the adverse effects of out-of-field teaching. Their study demonstrated that when out-of-field teachers received professional development tailored to their specific needs in science education, there was a marked improvement in student performance. This suggests that while out-of-field teaching presents challenges, these can be addressed through well-designed professional development programs that enhance teachers' content knowledge and pedagogical skills.

In China, Shen (2017) focused on aligning out-of-field teachers' instruction with national science standards. His research indicated that out-of-field teachers often struggled to align their teaching practices with the rigorous standards set by the national curriculum. This misalignment can lead to inconsistencies in the delivery of the science curriculum, potentially resulting in gaps in student knowledge and understanding. The study highlights the need for comprehensive support systems to help out-of-field teachers meet national educational standards.

In the Philippines, various studies have highlighted the widespread issue of out-of-field teaching in science and its impact on student achievement across different regions.

Gonzales and Torres (2019) conducted a study that revealed the prevalence of out-of-field teaching in rural areas. They found that a significant number of science teachers in these areas were teaching subjects outside their expertise, leading to substantial gaps in student achievement.

The lack of subject matter knowledge among these teachers often results in less effective instruction, which directly affects students' understanding and retention of scientific concepts.

De Guzman (2020) focused on the Visayas region and highlighted a critical barrier for out-of-field science teachers: the lack of access to professional development opportunities. This lack of training and support further exacerbates the challenges faced by these teachers, making it difficult for them to improve their content knowledge and teaching strategies. The study emphasized the need for more accessible and region-specific professional development programs to support out-of-field teachers in delivering quality science education.

In Metro Manila, Cruz and Bautista (2018) found that students taught by out-of-field science teachers scored lower in science subjects compared to those taught by teachers with a science background. This study provided quantitative evidence that out-of-field teaching also negatively impacts student performance in urban settings. The disparity in student scores underscores the importance of ensuring that teachers possess adequate subject-specific knowledge and pedagogical skills to teach science effectively.

Ramos (2017) investigated the challenges faced by out-of-field science teachers in Mindanao, particularly in utilizing laboratory equipment. The study found that these teachers often struggled with conducting experiments and using laboratory tools, which are crucial for hands-on science learning. The lack of familiarity with laboratory practices not only hampers the teaching process but also deprives students of valuable experiential learning opportunities, which are essential for a comprehensive understanding of scientific principles.

Finally, Mendoza (2021) examined the broader effects of out-of-field teaching on student motivation and interest in science across several schools in Luzon. The study found that students taught by out-of-field teachers exhibited lower motivation and interest in science subjects. This decreased enthusiasm for science can have long-term implications, potentially leading to fewer students pursuing science-related fields in higher education and careers. Mendoza's study highlights the importance of qualified and enthusiastic science teachers in fostering a positive attitude towards science among students.

The need to conduct this study in the Schools Division of Mabalacat City has been underscored by the persistent issue of out-of-field teaching and its adverse effects on student learning outcomes. Despite the growing recognition of this problem, there has been a lack of targeted professional development programs to address the specific needs of out-of-field science teachers in this region. By identifying the challenges and areas for improvement, this study provided a solid foundation for developing a professional development program that can enhance the competence of these teachers. This, in turn, is expected to lead to better student comprehension and performance in science, ultimately contributing to the overall quality of education in Mabalacat City.

Theoretical Framework

The theoretical framework for this study on the competence of out-of-field science teachers integrates key educational theories and models that elucidate how teacher competence impacts student outcomes. This framework incorporates the Teacher Quality Theory, Constructivist Learning Theory, and the Professional Development Model.

Teacher Quality Theory. Teacher Quality Theory emphasizes that the effectiveness of teaching is a primary determinant of student learning outcomes. Darling-Hammond (2015) asserts that teachers with strong subject matter knowledge and pedagogical skills significantly enhance student achievement. When teachers lack expertise in their assigned subjects, as is often the case with out-of-field teaching, they frequently struggle to deliver content effectively. This struggle results in lower student performance on standardized tests and reduced engagement with the subject matter (Smith & Ingersoll, 2015). The theory emphasizes the significance of subject-specific training and the detrimental effects of teaching subjects outside a teacher's area of expertise.

Constructivist Learning Theory. Constructivist Learning Theory, as articulated by Piaget and Vygotsky, posits that learning is an active process where students construct their understanding through experiences and interactions. Effective science teaching requires not only accurate content delivery but also the facilitation of interactive, inquiry-based learning. Out-of-field teachers, who may lack specialized training in science education, often struggle to implement these pedagogical strategies effectively. As a result, students may miss critical hands-on and experiential learning opportunities that are essential for deep scientific understanding (Hobbs, 2016; Shen, 2017). The theory emphasizes the importance of teachers possessing both content knowledge and pedagogical skills to support student learning through constructivist methods.

Professional Development Model. The Professional Development Model focuses on enhancing teachers' knowledge and skills through ongoing, targeted training. Guskey (2015) emphasizes that professional development should be tailored to teachers' specific needs and aligned with their instructional content. For out-of-field science teachers, professional development is crucial in addressing gaps in subject knowledge and pedagogical practices. Effective professional development programs can improve teachers' confidence and competence, leading to enhanced teaching practices and better student outcomes (Darling-Hammond et al., 2018). This model emphasizes the importance of targeted, ongoing support to help out-of-field teachers enhance their science teaching skills.

Integrative Discussion. This theoretical framework integrates the aforementioned theories to address the research focus on out-of-field science teachers. Teacher Quality Theory highlights the crucial role of subject matter expertise in effective teaching, while Constructivist Learning Theory emphasizes the importance of interactive, student-centered instructional methods. The

Professional Development Model provides a pathway for enhancing teachers' skills through focused training and support.

In the context of the Schools Division of Mabalacat City, this framework suggests that the competence of out-of-field science teachers is a complex issue involving both subject knowledge and pedagogical practices. By addressing these aspects through a well-designed professional development program, the study aims to improve the effectiveness of out-of-field science teachers, thereby enhancing student comprehension and performance in science.

The theoretical framework supports the development of a professional development program tailored to the specific needs of out-of-field science teachers. By enhancing teachers' content knowledge, pedagogical skills, and access to ongoing support, the program seeks to mitigate the adverse effects of out-of-field teaching and promote more favorable educational outcomes in science.

Conceptual Framework

The conceptual framework for this study on the competence of out-of-field science teachers is built upon the integration of several key concepts related to teacher effectiveness, student learning outcomes, and professional development. This framework combines elements of Teacher Competence, Student Achievement, and Professional Development to elucidate how addressing out-of-field teaching challenges can enhance science education.

Teacher Competence. Teacher competence refers to the proficiency of educators in both their subject matter and teaching methods. According to Darling-Hammond (2015), teacher competence encompasses not only a deep understanding of the subject being taught but also the ability to apply effective pedagogical strategies. In the context of out-of-field science teachers, competence is particularly crucial because these educators often lack specialized training in science, resulting in gaps in their ability to effectively convey scientific concepts (Smith & Ingersoll, 2015). The framework posits that increasing teacher competence through targeted interventions can lead to more effective science instruction and improved student outcomes.

Student Achievement. Student achievement measures students' understanding and performance in academic subjects. Research indicates that students taught by out-of-field teachers often exhibit lower achievement levels, as these teachers may struggle with delivering high-quality instruction (Cruz & Bautista, 2018). The conceptual framework posits that enhancing teacher competence will have a positive impact on student achievement. Improved teacher knowledge and pedagogical skills are expected to lead to better instructional quality, which in turn should result in higher student performance on assessments and greater understanding of scientific concepts (Gonzales & Torres, 2019).

Professional Development. Professional development refers to ongoing education and training designed to improve teachers' skills and knowledge. Guskey (2015) emphasizes that

effective professional development should be aligned with teachers' needs and directly related to their instructional practices. For out-of-field science teachers, professional development is essential for bridging the gaps in their subject knowledge and teaching methods. Targeted professional development programs can equip these teachers with the necessary skills to enhance their instructional practices, thereby improving their effectiveness in teaching science (Darling-Hammond et al., 2018). The framework incorporates the notion that well-designed professional development can address the specific challenges faced by out-of-field teachers, leading to improved teaching practices and, consequently, better student outcomes.

The conceptual framework integrates these concepts to address the issues associated with teaching science out of the field. The framework suggests that the lack of subject-specific knowledge and pedagogical skills among out-of-field teachers negatively impacts their teaching effectiveness and, consequently, student achievement. By focusing on improving teacher competence through targeted professional development, the framework proposes that it is possible to mitigate the adverse effects of teaching outside a teacher's field of expertise.

Teacher Competence is central to this framework, as it directly influences **Student Achievement**. The framework posits that enhancing teacher competence through **Professional Development** will lead to improved teaching quality and better student performance. Professional development programs specifically tailored to address the needs of out-of-field science teachers are expected to equip them with the skills and knowledge necessary to deliver effective science instruction.

This conceptual framework highlights the interconnection between teacher competence, student achievement, and professional development. It supports the development of a professional development program designed to enhance the competence of out-of-field science teachers. By addressing the gaps in teachers' subject knowledge and pedagogical skills, the program is expected to enhance the quality of science instruction and improve student learning outcomes in the Mabalacat City Schools Division.

Figure 1 illustrates the study's paradigm.

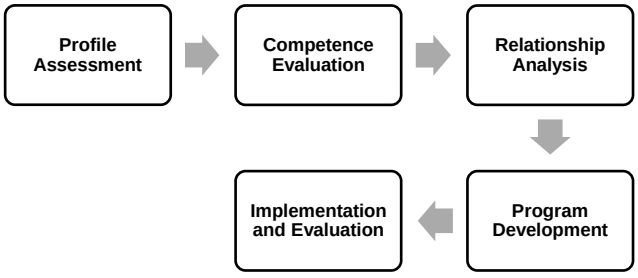

Figure 1. Paradigm of the Study

This paradigm provides a structured approach to understanding and addressing the challenges faced by out-of-field Science teachers. It emphasizes a systematic analysis of teacher profiles and competence, leading to targeted interventions that aim to improve both teaching practices and student learning outcomes.

Statement of the Problem

This study assessed the competence of out-of-field Science teachers in the Schools Division of Mabalacat City for the school year 2024-2025 as the basis for a professional development program to enhance the competence of the out-of-field Science teachers.

Specifically, it sought answers for the following questions:

1. What is the profile of out-of-field Science teachers in the Schools Division of Mabalacat City in terms of:

   1.1. Highest degree earned,

   1.2. Years of Science teaching experience, and

   1.3. Participation in Science-related Training?

2. What is the level of competence of out-of-field Science teachers?

3. What is the relationship between the profile of out-of-field Science teachers and their level of competence?

4. What type of professional development program can be proposed to address the needs of out-of-field Science teachers?

Hypothesis

The hypothesis of the study was tested at 0.05 level of significance.

There is no significant relationship between the profile of out-of-field Science teachers and their level of competence.

II. Methodology

This chapter outlines the research methodology used to investigate the competence of out-of-field Science teachers and their impact on educational outcomes. The study adopted a descriptive-correlational research design, where the descriptive component focused on profiling the teachers based on their highest educational attainment, field of specialization, years of teaching Science (regardless of alignment with their academic background), and participation in Science-related training. These variables were analyzed to understand their relevance to the teachers'

preparedness and capability to deliver effective Science instruction. The correlational aspect aimed to explore the relationship between these profile variables and the teachers' level of competence in teaching Science, identifying key factors that may influence instructional quality. The study was conducted among 80 out-of-field Science teachers within the Schools Division of Mabalacat City for the academic year 2024–2025. Participants were selected using simple random sampling to ensure representativeness and minimize bias. Data collection was conducted using a researcher-developed questionnaire, based on a comprehensive review of relevant literature, designed to capture both profile information and competence levels accurately. The data were analyzed using various statistical tools: frequency and percentage were used to describe the participants' profiles, weighted mean to assess their competence level, and Pearson r to determine the strength and significance of the relationships between profile characteristics and teaching competence. This methodology provided a structured approach to understanding the challenges and capabilities of out-of-field Science teachers, offering insights that could guide future interventions and targeted professional development programs to enhance Science education outcomes.

Ethical Considerations

This study adhered to key ethical principles to ensure participant protection and research integrity. Informed consent was obtained from all participants, who will be fully informed about the study's purpose, procedures, and any potential risks, and will understand their right to withdraw at any time. Confidentiality was strictly upheld, with all data anonymized and securely stored to protect participants' privacy. The study has maintained data integrity by ensuring accurate and unbiased data collection and analysis. Additionally, respect for participants is paramount, ensuring their dignity is maintained and that the study did not cause harm or discomfort. These measures are essential to conducting ethical and credible research.

III. Results and Discussion

This chapter presents the discussion of findings brought from the data gathering procedure. The data gathering procedures were based on the questions posited in the beginning of this study.

1. Description of the Profile of the Teacher

Table 1.1
Highest Degree Earned
N = 80

Highest Degree Earned	f	%
Doctoral degree	1	1
Earned doctoral units	20	25
Master's degree	39	49
Earned masteral units	16	20
Bachelor's degree	4	5
Total	80	100

The data from Table 1.1 reveals the educational qualifications of the 80 out-of-field science teachers included in the study. The majority, 49% (39 teachers), have obtained a master's degree, indicating that nearly half of the respondents have pursued advanced academic training, showcasing their commitment to professional growth. Furthermore, 25% (20 teachers) have earned units toward a doctoral degree, reflecting a considerable number of teachers actively advancing toward higher academic qualifications.

Interestingly, 20% (16 teachers) have partially completed their master's studies, suggesting a potential target group for encouragement to complete their degrees, which could enhance their competence in teaching science. Meanwhile, 5% (4 teachers) possess only a bachelor's degree, indicating the need for professional development interventions specifically aimed at bolstering their foundational skills and scientific knowledge.

Notably, only 1% (1 teacher) has completed a doctoral degree, representing the pinnacle of academic attainment within the group. This highlights an area of opportunity for fostering higher academic aspirations among the majority of out-of-field science teachers. These results collectively underscore a diverse range of educational qualifications, with a substantial proportion demonstrating a proactive attitude toward academic advancement.

Table 1.2
Years of Science Teaching Experience
N = 80

Years of Science Teaching Experience	f	%
20 years and over	2	3
15-19 years	21	26
10-14 years	39	49
5-9 years	14	17
less than 5 years	4	5
Total	80	100

The largest group, comprising 49% (39 teachers), has 10–14 years of experience, signifying a substantial proportion of teachers who have likely gained a moderate level of familiarity with science teaching through practice, even if they are not formally trained in the field. This group represents a significant resource for peer mentoring and may possess valuable insights into managing the challenges of out-of-field teaching.

The next largest group includes those with 15–19 years of experience, accounting for 26% (21 teachers). This group likely represents seasoned educators who have substantial teaching expertise, though potentially less specialized in science. These teachers may benefit from professional development focused on deepening subject-specific knowledge while leveraging their pedagogical experience.

Seventeen percent (14 teachers) have 5–9 years of experience, indicating an intermediate level of practice in teaching science. These teachers may be at a pivotal stage where targeted interventions can significantly influence their long-term competence in science teaching.

A smaller group, 5% (4 teachers), has less than 5 years of experience. This group may face unique challenges as they balance mastering the fundamentals of teaching with the added complexity of teaching a subject outside their expertise. Tailored professional development and mentoring for this cohort can help build their confidence and skills.

At the upper end, 3% (2 teachers) have 20 years or more of experience. These educators, while a minority, bring extensive teaching experience that can be instrumental in leadership roles or as mentors, provided they receive support to enhance their science content knowledge. This distribution underscores a broad range of teaching experiences, highlighting the need for differentiated professional development programs that address the unique needs of novice, mid-career, and veteran out-of-field science teachers.

Table 1.3
Participation in Science-Related Training
N = 80

Participation in Science-Related Training	f	%
Yes, regularly	17	21
Yes, occasionally	26	33
No, but interested	23	29
No, not interested	14	17
Total	80	100

The data reveals a mixed engagement with professional development activities, underscoring varying levels of interest and involvement. Twenty-one percent (17 teachers) reported participating in science-related training regularly. This group demonstrates a proactive commitment to improving their competence in science teaching. These teachers are likely to be open to further professional development initiatives and can serve as role models or catalysts in encouraging their peers.

The largest segment, 33% (26 teachers), participates occasionally in science-related training. This indicates some level of engagement, though perhaps constrained by factors such as availability, access, or competing professional priorities. Tailored programs and incentives could motivate this group to transition to more consistent participation.

A significant portion, 29% (23 teachers), has not participated in science-related training but expressed interest in doing so. This highlights a critical opportunity for intervention. Efforts should be directed toward addressing barriers to access and providing easily accessible, relevant, and engaging training opportunities for this group.

Notably, 17% (14 teachers) reported no participation in and no interest in science-related training. This group presents a challenge, as their lack of interest could stem from a range of factors such as perceived irrelevance, low confidence, or professional disengagement. Motivational strategies, coupled with practical and contextualized training programs, might help re-engage these teachers.

Overall, the data reflects a clear need for a differentiated approach to professional development. While some teachers are already actively involved or interested in science-related training, others require more targeted efforts to foster interest, remove barriers, and demonstrate the value of such training for their teaching efficacy and professional growth.

Table 1.4
Detailed List of Training Attended
N = 80

Category	f	%
International	2	2
National	2	3
Regional	6	7
Division	34	42
District	26	33
School	10	13
Total	80	100

The data reveals a concentration of training opportunities at the local level, with fewer teachers participating in higher-level training events. The majority of teachers, 42% (34 teachers), reported attending division-level training sessions. This suggests that division-led initiatives are the most accessible and widely participated professional development opportunities for these teachers. Such sessions likely play a central role in equipping teachers with essential skills and knowledge for science teaching.

Similarly, 33% (26 teachers) attended district-level training, indicating another significant avenue for professional development. Together with division-level training, these local programs form the backbone of accessible training opportunities for out-of-field science teachers.

Thirteen percent (10 teachers) attended school-level training. While these are the most localized and perhaps the most convenient, their relatively lower participation rate might indicate that school-level training is less frequent or less focused on science-related content.

Regional training attracted 7% (6 teachers), national training 3% (2 teachers), and international training only 2% (2 teachers). These numbers suggest that opportunities for broader and more advanced professional development are limited or less accessible to most out-of-field science teachers. Participation in such higher-level training could be constrained by factors such

as cost, distance, or limited slots. Yet, these programs often offer specialized content and global perspectives that could significantly enhance teaching competencies.

The distribution of training levels highlights a reliance on local initiatives to support the professional growth of out-of-field science teachers. While this approach ensures accessibility, there is a clear need to expand access to regional, national, and international training opportunities. Such exposure would provide teachers with advanced knowledge, innovative strategies, and broader professional networks, ultimately enhancing their competence and confidence in teaching science.

2. Description of the Level of Competence of Out-of-Field Science Teachers

Table 2
Level of Competence of Out-of-Field Science Teachers
N = 80

Learners' Attitudes	Mean	Verbal Description
Adaptability: Flexibility in adapting teaching methods to meet the diverse needs of students in Science.	4.78	Highly Competent
Critical Thinking Promotion: Encouragement of critical thinking and problem-solving skills through Science activities.	4.76	Highly Competent
Use of Science-Specific Resources: Proficiency in utilizing instructional materials and resources relevant to Science.	4.71	Highly Competent
Classroom Management: Skills in managing classroom behavior and creating a conducive learning environment for Science.	4.69	Highly Competent
Instructional Delivery: Effectiveness in presenting Science material in a clear and engaging manner.	4.49	Highly Competent
Curriculum Knowledge: Familiarity with the Science curriculum and standards used in the educational system.	4.46	Highly Competent
Professional Development: Participation in ongoing professional development related to Science education.	4.4	Highly Competent
Assessment Strategies: Ability to design and implement assessments that accurately measure students' understanding of Science concepts.	4.33	Highly Competent
Student Engagement: Techniques used to actively involve students in Science learning activities.	4.33	Highly Competent
Application of Scientific Methods: Ability to teach and apply scientific methods and inquiry processes in lessons.	3.61	Competent
Lesson Planning Skills: Ability to create detailed and effective lesson plans aligned with Science standards.	3.6	Competent
Collaboration with Colleagues: Engagement in collaborative efforts with other educators to enhance Science teaching and learning.	2.73	Moderately Competent
Feedback Utilization: Ability to use feedback from students and assessments to improve Science teaching practices.	2.68	Moderately Competent
Understanding of Science Content: Knowledge of key concepts, theories, and principles in Science.	2.43	Slightly Competent
Integration of Technology: Use of technological tools and resources to enhance Science instruction.	2.32	Slightly Competent
General Weighted Mean	3.89	Competent

With a general weighted mean of 3.89, these teachers are generally assessed as competent. The highest-rated competencies fall under the category of "Highly Competent," with scores ranging from 4.78 to 4.33. Teachers demonstrate exceptional adaptability (4.78), showcasing their flexibility in modifying teaching methods to address the diverse needs of learners. Similarly, their ability to promote critical thinking and problem-solving skills through science activities (4.76) is notable, emphasizing their effectiveness in fostering essential 21st-century skills. Proficiency in utilizing science-specific resources (4.71) also reflects their capability to integrate instructional materials relevant to the subject, which complements their strong classroom management skills (4.69). These competencies contribute to creating conducive and engaging learning environments. Moreover, instructional delivery (4.49) and curriculum knowledge (4.46) are areas where these teachers perform strongly, demonstrating their ability to present science content clearly while aligning with curriculum standards. Professional development (4.40) and assessment strategies (4.33) further highlight their commitment to growth and their ability to measure student understanding effectively.

However, areas requiring attention are evident in the "Competent" category, such as the application of scientific methods (3.61) and lesson planning skills (3.60), which indicate moderate proficiency in structuring lessons and guiding students through inquiry-based learning. Areas assessed as "Moderately Competent" include collaboration with colleagues (2.73) and feedback utilization (2.68). These scores suggest limited engagement in professional collaboration and insufficient integration of feedback to refine teaching practices. Notably, the lowest-rated competencies fall under the "Slightly Competent" category, with understanding of science content (2.43) and integration of technology (2.32) highlighting significant gaps. These findings reflect limited knowledge of scientific principles and theories, as well as a lack of proficiency in using technology to enhance instruction.

The results indicate that while out-of-field science teachers possess strong general teaching skills and demonstrate adaptability and resourcefulness, targeted professional development programs are necessary to address gaps in scientific content knowledge, technology integration, and collaborative practices. These interventions are crucial to elevating their competence and ensuring quality science education.

3. Relationship between the Profile of Out-Of-Field Science Teachers and their Level of Competence

Table 3
Relationship between the Profile of Out-Of-Field Science Teachers and their Level of Competence

Profile		**Level of Competence**
Highest Degree Earned	Pearson r:	0.022
	p-value:	0.908
	Interpretation:	Not Significant
Years of Science Teaching Experience	Pearson r:	0.033
	p-value:	0.862
	Interpretation:	Not Significant
Participation in Science-Related Training	Pearson r:	0.695
	p-value:	0.000
	Interpretation:	Significant
Trainings Attended	Pearson r:	0.507
	p-value:	0.004
	Interpretation:	Significant
Total	Pearson r:	0.876
	p-value:	0.000
	Interpretation:	Significant

The results indicate that certain aspects of the teachers' profiles are significantly associated with their competence, while others are not. The highest degree earned (Pearson r = 0.022, p-value = 0.908) and years of science teaching experience (Pearson r = 0.033, p-value = 0.862) show no significant relationship with the level of competence. This suggests that formal academic qualifications and the duration of teaching experience alone do not necessarily translate to higher competence levels in teaching science.

In contrast, participation in science-related training exhibits a strong and significant relationship with the level of competence (Pearson r = 0.695, p-value = 0.000). This highlights the critical role that ongoing professional development plays in enhancing the teaching abilities of out-of-field science teachers. Similarly, the frequency and scope of trainings attended also show a significant relationship (Pearson r = 0.507, p-value = 0.004), reinforcing the importance of diverse and accessible training opportunities. When these factors are considered collectively, the total profile of the teachers (Pearson r = 0.876, p-value = 0.000) demonstrates a highly significant relationship with their competence levels.

These findings underscore the pivotal impact of professional development and targeted training on the competence of out-of-field science teachers. While formal education and teaching experience provide a foundation, it is the active engagement in relevant training that significantly enhances their ability to teach science effectively. This highlights the need for structured and sustained professional development programs tailored to address the unique challenges faced by out-of-field science teachers.

4. Proposed Professional Development Program to Address the Needs of Out-Of-Field Science Teachers

Program Component	Objective	Activities/Strategies	Target Participants	Duration	Expected Outcome	Responsible Personnel
Science Content Mastery	Enhance understanding of key science concepts and theories.	- Subject-specific workshops - Peer mentoring - Online modules	Teachers with limited content knowledge	3 months (weekly sessions)	Improved knowledge of science content.	Science experts and trainers
Technology Integration	Develop skills in using digital tools for science teaching.	- Hands-on ICT training - Simulation-based learning - Resource sharing	All teachers	2 months (biweekly sessions)	Increased use of technology in science lessons.	ICT specialists, master teachers
Lesson Planning and Design	Strengthen lesson planning aligned with science standards.	- Collaborative lesson planning - Model lesson demonstrations	Teachers with moderate planning skills	1 month (intensive)	Creation of effective, standards-based lesson plans.	Curriculum specialists
Scientific Methods Training	Build competence in teaching inquiry and scientific methods.	- Inquiry-based teaching workshops - Experiments and fieldwork	All teachers	1 month (weekly sessions)	Effective implementation of inquiry-based learning.	Science educators and experts
Classroom Management	Improve ability to manage diverse learners in science classes.	- Role-playing scenarios - Behavioral management seminars	Teachers needing classroom strategies	1 month (weekly sessions)	Creation of a positive and controlled learning environment.	Guidance counselors, experts
Collaboration Enhancement	Foster teamwork among educators to improve teaching strategies.	- Professional learning communities - Peer observation and feedback	All teachers	Ongoing (monthly meetings)	Enhanced collaboration and sharing of best practices.	School administrators
Assessment Strategies	Equip teachers with tools to evaluate student understanding effectively.	- Rubric creation workshops - Performance-based assessment training	All teachers	2 months (weekly sessions)	Accurate and meaningful assessment of science learning.	Assessment specialists
Advanced Science Pedagogy	Introduce innovative strategies for science instruction.	- Differentiated instruction seminars - Project-based learning workshops	Teachers seeking advanced strategies	3 months (biweekly sessions)	Adoption of innovative teaching strategies.	Education consultants
Professional Motivation	Encourage continued growth and engagement in professional development.	- Inspirational talks - Incentives for training completion	Teachers with low motivation	Ongoing (quarterly)	Increased interest and participation in training.	School leaders

The proposed professional development program is designed to address the specific needs of out-of-field science teachers by focusing on enhancing their competencies in both content knowledge and pedagogy. Recognizing that these teachers often face challenges in mastering scientific concepts and applying effective teaching methods, the program is divided into key components targeting various areas of need.

A primary focus of the program is Science Content Mastery, which aims to deepen the teachers' understanding of fundamental science principles and theories. Through subject-specific workshops, peer mentoring, and online modules, teachers with limited knowledge in science can build their confidence and proficiency in the subject. This component ensures they can deliver accurate and clear explanations to their students, fostering a stronger foundation in science education.

Technology Integration is another critical aspect, equipping teachers with skills to utilize digital tools effectively in their science lessons. Hands-on ICT training and simulation-based learning sessions enable teachers to integrate technology into their classrooms, enhancing student engagement and understanding. As technology plays an increasingly significant role in education, this component ensures that teachers remain current and capable of using innovative resources.

To improve lesson preparation, the Lesson Planning and Design component offers collaborative workshops and model demonstrations. Teachers learn to align their lesson plans with curriculum standards, ensuring coherence and relevance. This component addresses the need for well-structured and purposeful lessons, particularly for teachers less experienced in science-specific planning.

The Scientific Methods Training focuses on building competence in teaching inquiry-based learning and the scientific method. Teachers participate in workshops emphasizing experiments, fieldwork, and hands-on activities, fostering a deeper appreciation for the investigative nature of science. This training ensures students are actively engaged in critical thinking and problem-solving tasks.

Classroom Management training supports teachers in maintaining a positive and effective learning environment. Through role-playing scenarios and behavioral management seminars, teachers develop strategies to manage diverse classroom dynamics, enabling them to handle challenges confidently and maintain focus on science learning. Similarly, the Collaboration Enhancement component encourages teamwork among teachers through professional learning communities and peer observations, promoting the exchange of best practices and collective problem-solving.

To improve evaluation methods, the Assessment Strategies component provides tools for designing meaningful assessments. Teachers gain expertise in creating rubrics and implementing performance-based evaluations, ensuring that their assessments accurately reflect student learning. Additionally, Advanced Science Pedagogy introduces innovative teaching methods such as

project-based learning and differentiated instruction, helping teachers refine their approaches and cater to diverse learning needs.

Finally, the program emphasizes Professional Motivation to inspire continued growth and participation in professional development. Through motivational talks and incentives, teachers are encouraged to engage actively in training opportunities and maintain enthusiasm for their professional roles.

IV. Conclusion

The findings reveal that while a significant number of out-of-field Science teachers hold a master's degree (49%), very few have pursued doctoral studies (1%), suggesting a gap in advanced academic qualifications. Most teachers possess substantial teaching experience, with nearly half (49%) having 10–14 years in the field, although a small percentage (5%) have under five years of experience. Participation in Science-related training is fairly common, with 21% regularly involved and 33% attending occasionally; however, 29% have not participated despite expressing interest, and 17% show no interest at all. Training sessions are primarily local in scope, with the majority attending division (42%) and district-level (33%) events, while only 2% and 3% participate in international and national trainings, respectively. In terms of competence, teachers scored highly in adaptability (4.78), promoting critical thinking (4.76), and utilizing science-specific resources (4.71); however, they showed lower competence in understanding Science content (2.43) and integrating technology (2.32). Correlational analysis revealed significant relationships between competence and both participation in Science-related training ($r = 0.695$, $p = 0.000$) and frequency of training attended ($r = 0.507$, $p = 0.004$). In contrast, no significant correlation was found with academic qualifications or years of teaching experience.

Based on these findings, several conclusions and recommendations are drawn. Out-of-field Science teachers generally exhibit strong pedagogical skills and adaptability but require support in deepening their content knowledge and effectively integrating technology. Although local training opportunities are widely accessible and attended, there remains limited access to national and international training platforms. Professional development through Science-related training significantly boosts teaching competence, emphasizing the importance of ongoing capacity-building efforts. Therefore, it is recommended to implement targeted professional development focusing on content mastery and technological skills, expand access to advanced training opportunities, and provide sustained, practical training on scientific inquiry methods. Additional support mechanisms, such as incentives and peer mentoring, should also be established to encourage participation, especially among less engaged teachers. Lastly, ongoing evaluation of training programs is essential to ensure their relevance and effectiveness in meeting the evolving needs of out-of-field Science educators.

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