

Exploring Scientific Inquiry: Secondary Teacher's Journey to Enhance Learners' Science Process Skills

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Abstract. This study revealed the application of scientific inquiry by secondary school teachers in augmenting learners' Science Process Skills. A total of 10 public Junior and Senior High School Science teachers from Babak District, Island Garden City of Samal participated in this research. Employing a phenomenological approach, the study explored their experiences, instructional practices, and insights. In-depth interviews and focus group discussion were conducted to gain perspectives on their coping strategies, teaching innovations, and reflections. Through thematic analysis, three key themes emerged: resource limitations, instructional innovations, and professional challenges. In response to limited laboratory access, teachers creatively integrate digital simulations, upcycling materials, and conventional equipment use. Professional development, collaboration among teachers, and learner-centered strategies emerged as enablers of effective inquiry-based instruction. Insights drawn emphasized resourcefulness, experiential learning, and scaffolding scientific thinking in learners. The findings highlight that even in under-resourced contexts, a resilient and innovative pedagogical approach can significantly enhance science learning outcomes. Moreover, the study reinforces the role of institutional support, practical teaching strategies, and continuous professional training in nurturing Science Skills.

KEY WORDS

1. Scientific inquiry 2. science process skills 3. phenomenology

Date Received: April 05, 2025 — Date Reviewed: May 15, 2025 — Date Published: June 18, 2025

1. Introduction

At present, many secondary schools continue to view Science and Technology as a challenging subject, despite the competence and preparedness of the teachers handling it. The difficulty appears to stem not from instruction, but from the learners' struggle to grasp and apply essential Science process skills. This suggests that the core of the problem lies in the learners' limited ability to engage with scientific inquiry and critical thinking, which are crucial for meaningful learning in Science. In Israel, Hofstein

(2019) found that learners often perceive experimental exercises as burdensome tasks that complicate their understanding of Science. Investigatory activities requiring the use of Science process skills are frequently misunderstood by learners as mere hurdles to overcome in order to pass the subject. This highlights a contextual issue within the Israeli education system, where practical Science activities are not fully appreciated as essential components of meaningful learning. Many learners continue to face

challenges in acquiring and applying Science Process Skills, which are crucial for developing intellectual, critical, and logical thinking abilities. This was emphasized by Kennepohl (2021) in his study in Canada, where students in suburban areas were found to struggle with fully internalizing these skills, limiting their capacity for meaningful and independent learning in Science. Duban et al. (2019) reported that in Turkey, learners experience significant difficulties in developing and applying Science Process Skills effectively. These challenges hinder their ability to engage in scientific inquiry and negatively impact the quality of Science education across various learning environments. In the Philippines, despite strong national directives under the Science Education Institute–Department of Science and Technology to foster 21st-century Science Process Skills, many students still exhibit deficiencies in applying these skills. As observed by Noroña (2021), these difficulties persist despite the presence of structured educational programs aimed at nurturing lifelong scientific learners. Mirana (2019) highlighted that students in the Bicol region continue to struggle with integrating Science Process Skills into practical learning. Although the K–12 curriculum aims to fuse scientific rea-

soning with environmental awareness, gaps in execution have made it difficult for learners to meet these expectations. In Eastern Samar, the lack of exposure to laboratory tools and insufficient use of scientific equipment significantly hinder learners' ability to develop Science Process Skills. According to Pareek (2019), these limitations—combined with inadequate support systems—impede students' growth in critical thinking and problem-solving as envisioned in the K–12 curriculum. Locally, in some National High Schools within Babak District, Island Garden City of Samal, Davao Region, there has been no existing study that assesses the current status of learners' Science Process Skills. This lack of data has contributed to ongoing challenges in achieving these essential skills, particularly in relation to Science competencies that require hands-on, laboratory-based learning. Science teachers in the Junior High School and Senior High School levels commonly face difficulties in delivering these competencies due to limited access to laboratory resources and materials. Given these persistent issues, the researcher is motivated to investigate the level of learners' mastery of Science Process Skills within the local context to address gaps and improve instructional practices.

1.1. Purpose of the Study—The purpose of this phenomenological study was to explore teachers' journeys in augmenting learners' Science Process Skills, focusing on their experiences in implementing scientific inquiry, utilizing available science laboratory resources, and facing the challenges associated with developing these skills among students. Specifically, the study aimed to gather significant insights from participants regarding their lived experiences in enhancing learners' Science Process Skills, based on the findings from the research conducted in Babak District, Island Garden City of Samal Division.

1.2. Research Questions—This study was conducted to explore the journey of Junior High and Senior High School Science teachers in developing and enhancing learners' Science Process Skills. The direction of the study was guided by the following specific research questions:

- (1) What are the experiences of teachers in their journey to augment learners' Science process skills?
- (2) What specific type of science laboratory resources that are useful to explore scientific inquiry?
- (3) What insights are drawn from the findings of the study?

1.3. Definition of Terms—The terms used in this study are the following: Science Laboratory Resources Refers to the various tools, equipment, materials, and facilities that are essential for conducting experiments, investigations, and practical activities in a scientific laboratory. In the study it is measured through its availability and utilization. Science Process Skills These terms are sequenced and evolved from Piaget’s work about developmental psychology that refers to the basic skills necessary to produce scientific information, perform scientific research and solve problems through observing, measuring, inferring, experimenting, and communicating.

1.4. Significant of the Study—This study will be beneficial to the Department of Education officials, school principals, Science teachers, learners, and future researchers. Teachers This study may be beneficial for teachers to focus on the enhancement of their teaching strategies in science, and nurture learners’ scientific curiosity, critical thinking, and practical skills, ultimately contributing to a more effective and impactful Science education. Also, it inspires teachers to leverage available tools and materials more effectively, creating engaging and hands-on learning experiences, to ensure that learners receive the all-out benefit from science laboratory activities. Learners This study will help learners to take a more proactive role in their learning journey, aligning their efforts with the competencies essential for scientific inquiry. Also, it will inspire learners’ sense of curiosity and critical thinking that extends beyond the classroom and into their future endeavors in the scientific field. School Principals This research will be the basis for principals to prioritize investments in well-equipped laboratories, ensuring that students have access to the necessary tools for hands-on experimentation and skill development. Additionally, they will

be aware of the link between learning competencies and science process skills which will enable them to target professional development opportunities for teachers, empowering them to enhance their instructional methods in science teaching. Department of Education Officials This will provide invaluable insights that can inform decision-making processes related to resource allocation and Science curriculum development. Also, DepEd officials and policy makers can make informed investments to enhance the learning competencies that contribute to the development of science process skills and enhance professional development programs for educators. This will also guide the formulation of evidence-based policies that promote the integration of practical, inquiry-based learning into the Science curriculum.

Future Researchers For future researchers, this study could provide a reproduction of previous findings in the literature. This research will be a helpful and additional contribution for their references for the future researches in the field of teaching. Also, they may engage into an inquiry on addressing the identified challenges on the insufficiency of science laboratory resources among public schools.

1.5. Theoretical Lens—This research study was based on Bandura’s Social Learning Theory (1997), which proposed that individuals are shaped by their environment. According to the theory, by intentionally creating a positive learning environment and exerting control over it, we can influence what we become. The

choices we make are driven by our beliefs and capabilities, with our environment playing a critical role in shaping our learning and actions. Bandura’s framework aimed to explain how individuals internalize societal norms and how ongoing interaction with the environment leads to lasting changes in performance and

potential. The study explored the development of learners' Science Process Skills and found a strong connection with self-efficacy beliefs, which significantly impacted learners' cognitive, motivational, emotional, and decision-making processes. In the context of the study, learners' self-efficacy influenced their engagement with scientific inquiry, determining whether they approached experiments with confidence or avoided challenges. The findings suggested that self-efficacy played a crucial role in motivating students to set and pursue challenging goals, thereby enhancing their mastery of Science Process Skills. The study highlighted that fostering positive self-efficacy in learners led to greater success in science education by promoting a more active and determined approach to learning. The study on learners' Science Process Skills was also grounded in Piaget's theory of cognitive development (1952), which emphasized that learners adapted to their environment through the stages of assimilation and accommodation. In the context of science education, learners initially attempted to assimilate new scientific concepts and processes into their existing knowledge and skills. When faced with unfamiliar scientific phenomena or tasks, learners underwent accommodation by modifying or creating new schemas to integrate these new experiences. Piaget's theory high-

lighted the dynamic nature of learning, which was crucial for the development of Science Process Skills, as learners continually adapted and refined their understanding of scientific concepts through hands-on inquiry and experimentation. The study was supported by the concept that learners adapt their understanding of scientific concepts through two key cognitive processes: assimilation and accommodation. When learners encountered new scientific phenomena, they first attempted to integrate these experiences into their existing knowledge structures, a process known as assimilation. However, when confronted with unfamiliar or complex concepts, learners modified their cognitive frameworks or created new ones to better understand the new information, known as accommodation. This continuous adaptation was crucial in developing Science Process Skills, as it allowed learners to refine their scientific thinking and inquiry methods through practical experiences and experimentation. The conceptual framework of the study was presented in figure 1. Based on the figure, there were three interconnected variables. These variables were the experiences of teachers in their journey to augment learners' Science process skills; specific type of science laboratory resources useful to explore scientific inquiry; and insights are drawn from the findings of the study.

2. Methodology

This chapter of the study presented the method, research participants, data collection, the role of the researcher, data analysis, trustworthiness of the study, and ethical considerations. Exploring facts and knowledge in this study necessitated the design and implementation process, as elaborated in this chapter. The three most common qualitative methods used were participant observation, in-depth interviews, and focus groups, with each method suited for obtaining specific types of data. Participant observation was appropriate for collecting data on naturally occurring behavior in its usual context, in-depth interviews (IDI) were optimal for gathering personal histories, perspectives, and experiences, especially for sensitive topics, and focus groups were effective in eliciting data on cultural norms and generating broad overviews of issues concerning the cultural groups or subgroups represented. Phenomenology is a key approach in qualitative research that explores human lived experiences. It aims to describe how individuals encounter a phenomenon,

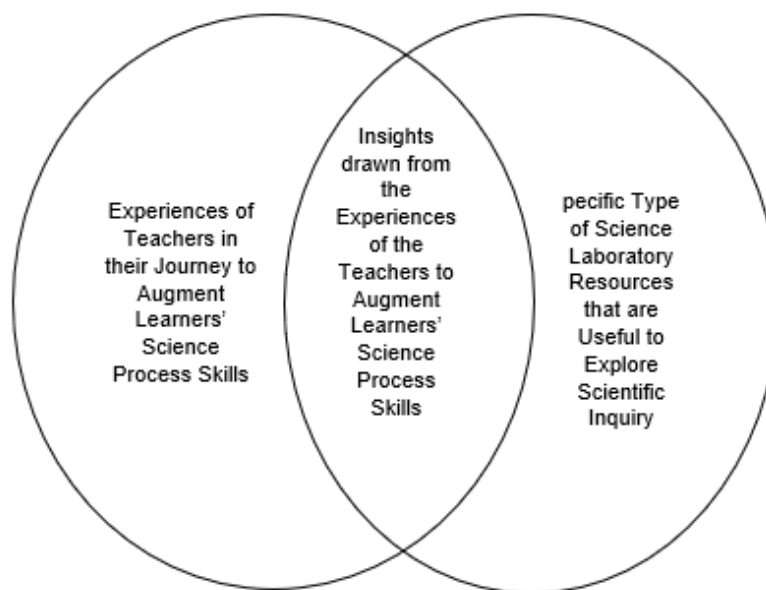


Fig. 1. The Conceptual Framework of the Study

articulating their perceptions and interpretations in both universal and contextual terms. This approach captures the essence of what individuals experience and how they perceive those experiences (Creswell, 2020). Additionally, phenomenology is applied in various disciplines such as psychology, sociology, and education, providing a deep and detailed understanding of human consciousness. Through methods like in-depth interviews, focus group discussion, observations, and the analysis of lived experiences, phenomenology helps to unravel the complexities of human existence, offering insight into the subjective aspects of our collective reality.

2.1. Philosophical Assumptions—The philosophical assumptions provided a framework for gathering, analyzing, and interpreting data in the study, helping to establish a basis for conclusions and decisions. These assumptions guided the selection of the research topic and the paradigm, which were central to understanding how secondary teachers worked to enhance learners' science process skills. According to Stanage (1987), the concept of 'paradigm' originates from the Greek and Latin meanings of pattern or model, signifying a guide for action in research design. Denzin and Lincoln (2000) reinforced this, suggesting that a research paradigm consists of fundamental beliefs that shape actions and are closely tied to the researcher's worldview. In this study, the selected paradigm shaped how teachers' experiences were explored in relation to their efforts to improve science process skills in learners. **Ontology** In this context, focused on the nature of reality as perceived by participants—the secondary teachers in this study. As Creswell (2020) explained, reality is subjective and constructed by the individuals involved. In this research, multiple realities emerged as teachers shared their experiences of using science laboratory resources to enhance science process skills among their students. These perspectives varied based on each teacher's unique approach to challenges and strategies in the classroom. By examining these multiple realities, the study

aimed to capture a comprehensive understanding of how teachers navigated their teaching environment to support their learners' development of scientific inquiry skills. Epistemology In this study emphasized the importance of firsthand information from participants to understand how knowledge was constructed in the context of teaching science process skills. Creswell (2020) stated that researchers should minimize the distance between themselves and the participants to gain deeper insights into the experiences being studied. In this case, the researcher spent time in classrooms, engaging directly with teachers and gathering data on their approaches to science teaching. By using thematic analysis, the researcher examined the teachers' narratives to uncover common themes and insights related to the challenges and successes they faced in fostering scientific inquiry skills among learners. Axiology In this study highlighted the role of values in shaping both the research process and the interpretation of data. Creswell (2020) argued that the values of the researcher significantly impact how the study is conducted and how findings are understood. In this case, the researcher main-

tained the integrity and dignity of the teachers' responses, ensuring their perspectives were honored while interpreting the data. The researcher acknowledged the value-laden nature of the study and made efforts to present an accurate representation of the teachers' experiences in implementing strategies to enhance learners' science process skills. Through this approach, the study aimed to ensure that the voices of the participants were authentically reflected in the findings. Rhetoric In this study, referred to presenting the research findings from the perspective of the teachers involved. By using a personal voice and qualitative terms, the researcher aimed to offer a nuanced account of the teachers' experiences in enhancing learners' science process skills. The use of the first person in reporting the findings allowed the researcher to clarify the complexities of the experiences of secondary teachers as they navigated the challenges of improving science process skills. This approach ensured that the narrative was grounded in the realities of the participants, offering an accurate and comprehensive view of how teachers addressed these challenges.

2.2. *Qualitative Assumptions*—Methodology was different from method. Methodology was creative and responsive approach to understand questions and subject matter while method refers to the exact knowledge and procedure (Gerodias, 2013). In this study the learners' Science process skills experienced by the junior high and senior high school teachers in Babak District, Island Garden City of Samal Division were gathered through an In-Depth Interview (IDI) and Focus Group Discussion (FGD) were extracted from the participants. The researcher's effort in knowing the deeper implication of learners' Science process skills for junior high and senior high school Science teachers became the basis for doing this qualitative

research, a means of which Gerodias, (2013) considered helpful in looking for "meanings and motivations that underline cultural symbols, personal experiences and phenomena". By using phenomenology, this need was hoped to be addressed by exploring the journey experienced by junior high and senior high school Science teachers in developing and enhancing learners' Science process skills in a manner that, the themes, symbols and meaning of the experiences presented. Phenomenological research was based on two premises. The first was that experience was a valid, rich and rewarding source of knowledge. From the definition, human experience was viewed as a cornerstone of knowledge about human phenomena and not

as an unreliable source. The second premise of phenomenological research lies in the view that the everyday world is a valuable and productive source of knowledge, and that we can learn much about ourselves and reap key insights into the nature of an event by analyzing how it occurs in our daily lives (Creswell, 2020). By do-

ing phenomenology which concerns with that “what” and the “how” (Creswell, 2020), the researcher projected that the journey experienced by the junior high and senior high school Science teachers were explored and insights drawn the basis for the possible future researches and policy analysis in relation to this research.

2.3. Design and Procedure—This research employed a phenomenological approach to illuminate specific phenomena by examining how they were perceived in a given context. In the human realm, this typically involved gathering in-depth information, FGD, and insights through qualitative methods such as interviews, discussions, and participant observation, presenting the findings from the participants’ perspectives. Phenomenology focused on studying experiences from the individual’s viewpoint, “bracketing” preconceived assumptions and conventional ways of understanding. Epistemologically, phenomenological approaches were grounded in a paradigm of personal knowledge and subjectivity, highlighting the significance of personal perspective and interpretation. These approaches proved valuable in understanding subjective experiences, gaining insights into

people’s motivations and actions, and challenging ingrained assumptions and conventional beliefs. As a qualitative research method, phenomenology aligned with the idea that individual perceptions directly influenced actions and responses. The goal of the phenomenological approach was to explore and identify phenomena based on how they were perceived by the individuals involved. This approach involved gathering profound insights through qualitative methods such as interviews, discussions, and participant observation, with a focus on representing the findings from the participants’ viewpoints (Creswell, 2020). Phenomenology served as an appropriate philosophical methodology that the researcher applied to explore the experiences of junior high and senior high school science teachers in their efforts to enhance learners’ science process skills.

2.4. Research Participants—Qualitative analysis typically required a smaller sample size compared to quantitative analyses. In this study, the sample size was determined to be sufficient to gather a comprehensive range of perspectives, with the goal of reaching data saturation. Saturation occurred when the inclusion of additional participants no longer produced new insights or information. There were no rigid rules for determining the appropriate sample size in qualitative research; rather, the number of participants was influenced by the time available, the resources at hand, and the overall objectives of the study (Creswell, 2020). Purposive sam-

pling was employed to identify participants for this research. This non-probability sampling technique involved the deliberate selection of individuals based on specific characteristics relevant to the research goals. Also referred to as selective or subjective sampling, this method enabled the researcher to intentionally select participants who were most capable of providing meaningful insights into the phenomenon under investigation. For this study, the researcher invited six public Junior High School Science teachers to participate in in-depth interviews and four public Senior High School Science teachers to participate in focus group discus-

sion from Babak District, Island Garden City of Samal Division. The inclusion criteria required participants to be currently teaching in public junior or senior high schools within the district and to have at least five years of experience in public secondary education. The data gathered from these participants were used to identify emerging themes and patterns based on their lived experiences. The use of purposive sampling was appropriate for the nature of

this study, as the selection of participants was aligned with the research's purpose and focus (Creswell, 2020). This sampling method, also known as judgmental or selective sampling, ensured that the individuals included in the study could provide authentic and relevant data. The intentional selection process contributed to the trustworthiness of the findings, as supported by Marshall (1996).

2.5. Ethical Considerations—Ethical considerations held significant weight in the overall design of this research study. The researcher carefully considered various ethical concerns related to the participants involved in this fieldwork. These ethical considerations were recognized as a critical component of the research process. The researcher remained committed to promoting the core aims of the study—imparting credible knowledge, upholding truth, and minimizing the possibility of error. **Social Value** This study emphasized the importance of research in serving societal needs. It specifically examined the lived experiences of junior high and senior high school Science teachers in relation to enhancing learners' science process skills. The findings served as a potential foundation for school authorities to create support programs and formulate actionable solutions that could benefit Science educators. The pressing concern that motivated the study involved the challenges faced by Science teachers in cultivating scientific inquiry within their classrooms. **Informed Consent** The study adhered to the Treaty Principle of Participation as cited by McLeod (2009). The researcher ensured that all participants were invited voluntarily and were well-informed about the nature of the research. All recruitment protocols were documented in the study's appendices. Prior to interviews, participants received a formal consent form detailing the study's purpose, contact

information, and expectations for their involvement. Each respondent signed an agreement confirming their willingness to participate, and the researcher ensured that informed, ethical practice guided every stage of data collection. **Vulnerability of Research Participants** All participants were qualified Science teachers from public secondary schools and were deemed capable of responding to the research questions. The researcher provided participants with contact information and remained accessible for any clarifications. This open communication helped establish trust and reassured participants throughout the research process.

Risks, Benefits, and Safety Participation in the study involved no coercion or undue influence. Respondents were informed of their right to withdraw at any time and were provided with contact details of the panel members for transparency. Interviews were conducted in secure venues during times convenient for the participants. To uphold confidentiality, pseudonyms were used, and every effort was made to protect the privacy and safety of respondents. **Privacy and Confidentiality of Information** This study complied with the Data Privacy Act of 2002. The identities of participants were anonymized, and all collected data were treated with the highest level of confidentiality. Printed materials and outputs maintained this anonymity, and no personal biases were allowed to affect the analysis or presentation of the findings. **Justice Partici-**

pants were informed of their roles and responsibilities in the research process. They were asked to answer honestly and were reassured that they would benefit directly from the study's outcomes. Communication throughout the research emphasized integrity and fairness.

Transparency The results of the study were made accessible to the respondents and school administrators. Participants were given the opportunity to review and verify their transcripts before final analysis. They were allowed to amend or remove information they felt could compromise their anonymity. The researcher maintained transparency by using pseudonyms and altering minor details to protect identities. **Qualification of the Researcher** The researcher ensured that he was academically and professionally prepared to undertake the study. Having fulfilled all academic requirements, including comprehensive examinations, the researcher demonstrated readiness—intellectually, emotionally, physically, and financially—to complete the study. The adviser-researcher collabora-

tion ensured academic rigor and successful completion. **Adequacy of Facilities** The researcher took proactive steps to meet the study's logistical and technical requirements within the allotted time-frame. Adequate resources and funding were allocated, and the technical committee's feedback played a key role in enhancing the manuscript. **Community Involvement** The researcher respected the traditions and cultural values of all participants. There was no use of deception in participant recruitment or data collection. Gratitude was expressed for the sincere participation of the Science teachers who shared their valuable experiences. **Plagiarism and Fabrication** The researcher followed proper citation practices and rephrased existing works using their own understanding. Quotes were used appropriately, and the manuscript was developed with honesty and authenticity. No data were fabricated or misrepresented, and all findings were based on the actual insights shared by the participants.

2.6. Role of the Researcher—The researcher held the responsibility of uncovering, transferring, and utilizing knowledge for the benefit of educational institutions. To fulfill this responsibility, the researcher assumed several key roles throughout the conduct of the study: **Facilitator and Promoter of Unbiased Research** The researcher conducted interviews with the participants and guided them throughout the process. Interpretations of the participants' ideas and responses were based on existing literature and related studies rather than the researcher's personal knowledge, opinions, or emotions, thereby avoiding the intrusion of bias. **Expert in Qualitative Methods** The researcher ensured the proper implementation of qualitative methods. To accomplish this, self-assessment was conducted, focus group discussion and guidance was sought from the research

adviser and other research professionals. This collaboration allowed the researcher to demonstrate competence in explaining the study objectively, conducting interviews in alignment with the research design, making accurate field observations, and appropriately selecting artifacts, images, and journal entries. Moreover, **Environmental Triangulation and Thematic Content Analysis** were employed precisely and rigorously. **Collector and Keeper of Data** The researcher utilized multiple methods to document what was said and done during the interviews, including handwritten notes, audio recordings, and/or video recordings. These recordings were then transcribed verbatim before analysis commenced. As the collected data contained sensitive and confidential information, the researcher ensured that all records were securely stored. **Safeguarding both the participants and their**

data remained a primary responsibility. Mechanisms for ensuring data protection were clearly communicated to participants and received approval from the relevant research ethics review board before data collection began. Analyst of Data The researcher interpreted the phenomenon from the perspectives of the participants. This included transcribing and verifying the data, reading between the lines, coding, and identifying themes. Great care was taken to ensure that the findings accurately reflected the

participants' voices and lived experiences.

Organizer and Presenter of Data The researcher presented the research problem alongside relevant literature and related studies to provide a comprehensive foundation for the study. The findings were organized according to each research question, with themes used to illustrate how the questions were answered. Additionally, the researcher offered future directions and implications of the findings for the enhancement of educational policies and practices.

2.7. Data Collection—The following were the step-by-step process of gathering the data needed. Securing Endorsement from the Dean of Graduate School The researcher asked an endorsement from the Dean of Graduate School of Rizal Memorial Colleges as one of the documents needed for submission to the office of the Schools Division Superintendent in asking permission to conduct study. Asking Permission from the Schools Division Superintendent The researcher asked permission from the Schools Division Superintendent to conduct the study in the identified school. The researcher sent a letter addressed to the Schools Division Superintendent with the attached Chapter 1 and 2 together with the research instrument which explains the objectives of the study and the identification of the participants. The researcher will wait for the response of the SDS before the conduct of it. Asking Permission from the School Heads After securing the approval of the SDS, the researcher sent letters to the principals of the schools explaining about the study to be conducted in their school. Obtaining Consent from the Participants The researcher asked permission from the participants. They were formally oriented about the study and of the process they

shall go through as participants. Conducting the Interview The researcher conducted the in-depth interview using the interview questions. The profile of the participants was taken, jotted down notes, and conversations was record using a sound recorder for ease of transcription. The researcher carefully listens and responded actively during the interviews. Transcribing the Responses of the Interviewees The researcher transcribed the responses of the interviewees precisely by recalling their answers from the sound recorder. If the participants used their vernacular language, the researcher translated it to English language. Data Coding and Thematic Content Analysis After the transcription, the data will then be categorized and coded. Then, themes were extracted and individual data within the participants was compared and contrasted. The researcher then conducted a second round of interviews (FGD) to corroborate any data that needs further explanation and input from the participants, Additional information gathered were examined thoroughly and integrate it into the existing body of data. After which, data were compared and contrasted between the participants in order to come up with patterns and trends.

2.8. Data Analysis—In this study, thematic analysis was utilized to analyze the gath-

ered data. The researcher analyzed the answers of the participants from the conducted inter-

views with the use of Creswell's Model specifically the identifying of themes approach. According to Creswell (2020) themes in qualitative research are similar codes aggregated together to form a major idea in the database. Familiarization with the data was common to all forms of qualitative analysis, the researcher immersed herself in, and became intimately familiar with, their data; reading and re-reading the data and noting any initial analytic observations. Coding Was also a common element of many approaches to qualitative analysis, involves generating pithy labels for important features of the data of relevance to the (broad) research question guiding the analysis. Coding was not simply a method of data reduction; it was also an analytic process, so codes capture both a semantic and conceptual reading of the data. The researcher coded every data item and ends this phase by collating all their codes and relevant data extracts. Searching for Themes Was coherent and meaningful pattern in the data relevant to the research question. The researcher ended this phase by collating all the coded data relevant to each theme. Reviewing Themes The researcher reflected on whether the themes tell a convincing and compelling story about the data, and began to define the nature of each individual theme, and the relationship between the themes. For these, Thematic Content Analysis was employed by the researcher. Thematic Content Analysis was a descriptive presentation of qualitative data in which a detailed analysis of each

theme was made by identifying the 'essence' of each theme and constructing a concise, punchy and informative name for each theme (Anderesen, 2013). In addition, to enhance validity and to create a more in-depth picture of the phenomenon, Environmental Triangulation was also be employed by the researcher. It was a technique to analyze the results of the same study using different methods of data collection. The key was identifying which environmental factors, if any, might influence the information that is received during the study. These environmental factors are changed to see if the findings are the same across the settings (David, 2015). This type of triangulation uses different settings, locations and other factors such as time, day, season in which the study took place. The idea was to determine which of these factors influence the information received, these factors are then changed to see if the findings are the same. If the findings remain unaltered under varying environmental factors, then validity can be established (Naeem, Saira, 2019). In this study, such triangulation was used considering that the requirements as mentioned was the use of environmental triangulation best suited the environment of the research being conducted. Writing-up Involves weaving together the analytic narrative and data extracts to tell the reader a coherent and persuasive story about the data, and contextualizing it in relation to existing literature.

2.9. Framework of Analysis—The framework analysis of this research was flexible to allow the researcher to either collect all the data and then analyze it or do data analysis during the collection process. In the analysis stage the gathered data was sifted, charted and sorted in accordance with key issues and themes. This involves a five-step process: familiarization, identifying a thematic framework, indexing, charting, and

mapping and interpretation (Ritchie Spencer, 1994). Familiarization refers to the process during which the researcher becomes familiarized with the transcripts of the data collected (i.e. interview or focus group transcripts, observation or field notes) and gains an overview of the collected data (Ritchie Spencer, 1994). In other words, the researcher becomes immersed in the data by listening to audiotapes, studying

the field or reading the transcripts. Throughout this process the researcher will become aware of key ideas and recurrent themes and make a note of them. Due to the sheer volume of data that can be collected in qualitative research the researcher may not be able to review all of the material. Thus, a selection of the data set would be utilized. The selection would depend on several aspects of the data collection process. For example, the mix of methods used (e.g. interviews, documents, observations), Identifying a thematic framework, the second stage, occurs after familiarization when the researcher recognizes emerging themes or issues in the data set. These emerging themes or issues may have arisen from a priori themes or issues however it is at this stage that the researcher must allow the data to dictate the themes and issues. To achieve this end the researcher uses the notes taken during the familiarization stage. The key issues, concepts and themes that have been expressed by the participants now form the basis of a thematic framework that can be used to filter and classify the data (Ritchie & Spencer, 1994). Indexing means that one identifies portions or sections of the data that correspond to

a particular theme. This process is applied to all the textual data that has been gathered (i.e. transcripts of interviews). For the sake of convenience Ritchie and Spencer recommend that a numerical system be used for the indexing references and annotated in the margin beside the text (1994). Qualitative data analysis tools are ideal for such a task. The final stage, mapping and interpretation, involves the analysis of the key characteristics as laid out in the charts. This analysis should be able to provide a schematic diagram of the event/phenomenon thus guiding the researcher in their interpretation of the data set. It was at this point that the researcher was cognizant of the objectives of qualitative analysis, which are: “defining concepts, mapping range and nature of phenomena, creating typologies, finding associations, providing explanations, and developing strategies” (Ritchie and Spencer, 1994:186). Once again, these concepts, technologies, and associations are reflective of the participant. Therefore, any strategy or recommendations made by the researcher echo the true attitudes, beliefs, and values of the participants.

2.10. Trustworthiness of the Study—Trustworthiness was all about establishing credibility, transferability, confirmability and dependability. In qualitative study, trustworthiness was very important because the result and finding of the research study would depend on the process of how it was being conducted by the researcher. Trustworthiness of a research study is important to evaluating its worth. Due to the nature of qualitative study, honesty in all the data and details are required. Trustworthiness makes the researcher’s study worthy to read, share, and be proud of. Credibility Was how confident the qualitative researcher was in the truth of the research study’s findings. The researcher in this study believed that honesty in everything you do

was essential to attain worthwhile success. The researcher has no derogatory records or administrative issues which ruin her integrity. Lincoln and Guba (2000) state that credibility refers to the idea of internal consistency, where the main issue was “how we ensure rigor in the research process and how we communicate to others that we have done so.” Transferability Is how the qualitative researcher demonstrates that the research study’s findings are applicable to other contexts. In this case, “other contexts” can mean similar situations, similar populations, and similar phenomena. The researcher has already studied the effects brought about by the learners’ Science process skills. The development and enhancement of learners’ Science process

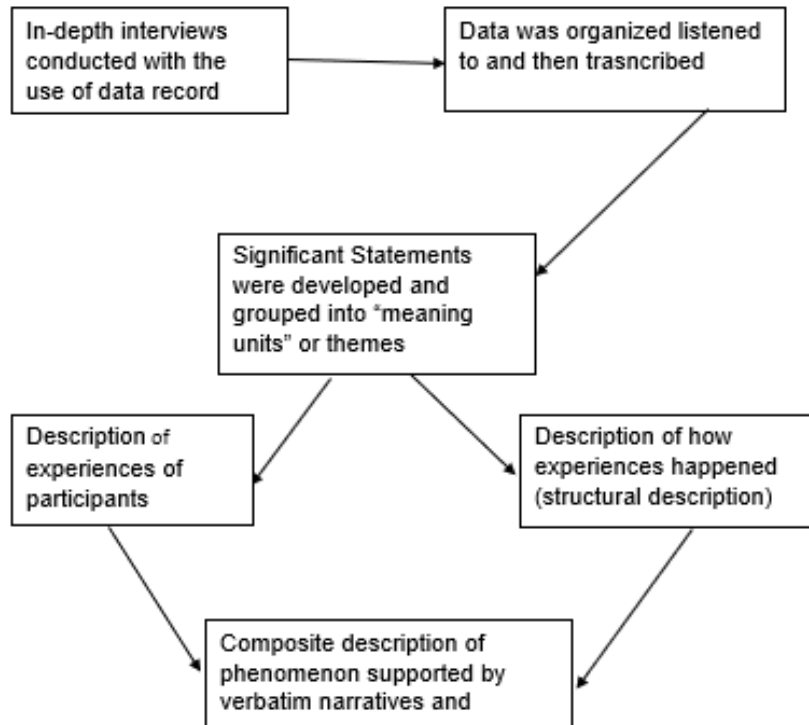


Fig. 2. Analytical Framework of the Study

skills is essential to the present educational field specifically in Science and Technology department. With this, researcher is interested to know the junior high and senior high school Science teachers' perspectives. Gasson (2004) emphasizes transferability as the extent to reader was able to provide generalization study based on his own context and can able to address that core issue of "how far a researcher may make claims for a general application of theory." Confirmability Was the degree of neutrality in the research study's findings. In other words, this means that the findings are based on participants' responses and not any potential bias or personal motivations of the researcher. This involves making sure that researcher bias does not skew the interpretation of what the research participants said to fit a certain narrative. The information using the audit trail in this situation is thoughtfully recorded by the researcher which highlights every step of data analysis that was made in order to provide a rationale for the

decisions made. This helps establish that the research study's findings accurately portray participants' responses. Gasson (2004) states that confirmability was based on the acknowledgment that research is never objective.

Dependability Was the extent that the study could be repeated by other researchers and that the findings would be consistent. In other words, if a person wanted to replicate your study, they should have enough information from your research report to do so and obtain similar findings as your study did. A qualitative researcher used inquiry audit in order to establish dependability which requires an outside person to review and examine the research process and the data analysis in order to ensure that the findings are consistent and could be repeated. In this component, the use of database was very important in backing up information collected and noting changes for all types of research studies. All the data collected was properly kept for future use as references. Gasson (2004) stated that

dependability deals with the core issue that “the way in which a study is conducted should be consistent across time, researchers, and analysis techniques.

3. Results and Discussion

In this chapter, the results of the study are presented and discussed with reference to the aim of the study. The themes that emerged from the data gathered are discussed in this chapter. The results present the description and background of the participants who are assigned to pseudonyms to conceal their identity.

3.1. Strengthening of Teachers in their Journey to Augment Learners’ Science Process Skills—Science teachers’ experiences in implementing inquiry-based science instruction reveal both rewarding opportunities and significant challenges in promoting learners’ science process skills. Throughout the study, participants shared that inquiry-driven approaches allowed them to shift from traditional lecture methods toward more hands-on, exploratory strategies—encouraging students to observe, question, and investigate. These methods fostered deeper student engagement and developed critical thinking, especially when learners were given the freedom to test ideas and draw conclusions from their own observations. However, teachers also encountered limitations in implementing full-scale inquiry activities due to resource shortages, large class sizes, and varying levels of learner readiness. Some students struggled with active participation in group tasks, while others lacked foundational skills in observation and analysis. Despite these constraints, teachers demonstrated resilience by improvising instructional materials using low-cost or recycled items, and by encouraging science-based exploration within the learners’ homes and communities. Constant communication with students and collaboration among colleagues were cited as vital in sustaining inquiry even in resource-constrained environments. The research further highlighted the emotional and professional demands associated with facilitating inquiry-based learning. Many teachers expressed feelings of exhaustion, citing the additional workload required to design experiments, monitor group work, and assess process-oriented tasks. Still, they emphasized the critical role of professional development and peer collaboration in overcoming these difficulties, particularly in refining strategies for process-based assessment and classroom management during hands-on activities. Despite the hurdles, teachers remained deeply committed to their role in cultivating scientific thinking. They continuously reflected on and adjusted their practices to ensure that inquiry remained accessible, engaging, and meaningful for all learners. Their passion for making science “come alive” in the classroom demonstrated their dedication not only to content mastery but to nurturing the scientific habits of mind that students will carry beyond the school setting.

3.1.1. Resource Limitations—The interview responses from teacher-participants revealed a consistent challenge in implementing the science inquiry approach due to significant resource limitations. Teachers emphasized that the lack of essential laboratory tools—such as microscopes, test tubes, and basic chemicals—hindered learners’ opportunities to fully engage in hands-on, investigative activities that are crucial for developing science process skills. In many cases, teachers were compelled to improvise using recycled or household mate-

rials, or even fund the needed resources out of pocket, highlighting the inequity faced by both educators and students in under-resourced schools. Despite their commitment to making science meaningful and inquiry-driven, the scarcity of materials continues to restrict the depth and quality of students' scientific experiences. Moreover, it has been noted that many public schools in the Philippines continue to experience difficulties due to inadequate science laboratory facilities, equipment, and learning materials—a concern also reflected in the results of international assessments like TIMSS and the 2018 PISA. This situation reportedly leads some science teachers to forgo important laboratory activities, particularly when alternatives or improvised materials are not readily available. These constraints are believed to hinder learners from acquiring key competencies necessary for developing their science process skills, which aligns with the concerns raised by the teacher-participants in the present study regarding resource limitations (Hadji Abas Marasigan, 2020). Limited emphasis on science laboratories, particularly in public schools, directly affects teachers' ability to provide meaningful scientific inquiry experiences that develop learners' Science Process Skills. Challenges such

as the shortage of laboratory facilities, lack of essential materials, minimal training for Science teachers, and insufficient safety protocols during experiments hinder hands-on learning. These constraints mirror the struggles encountered by teachers as they strive to enhance learners' scientific skills through inquiry-based approaches. Their experiences reflect how limited resources impact the implementation of effective science instruction and the development of critical thinking and investigative competencies (Maranan, 2019). Addressing the inadequacy of laboratory resources is crucial to ensuring inclusive and high-quality education, especially in secondary schools where teachers often observe that such limitations restrict learners from engaging in practical, skill-building activities. These challenges hinder the development of essential Science Process Skills, as learners are unable to fully participate in inquiry-based tasks. Teachers emphasized that closing these resource gaps is necessary for learners to effectively acquire and apply scientific thinking and investigative strategies. These experiences align with the present study's focus on resource-related challenges in science instruction and how they shape teachers' efforts to enhance learners' inquiry skills (Ma et al., 2019).

3.1.2. Instructional Innovations—Science teachers recognize the significance of instructional innovations as essential strategies in nurturing students' science process skills, especially when resources are limited. By utilizing online simulations like PhET (Physics Education Technology) and designing their own makeshift science kits from everyday materials, they ensure that learners still experience hands-on, inquiry-based learning. Collaboration among teachers, such as sharing materials and co-creating activities, fosters a supportive environment that enhances creativity and problem-solving in science instruction. Additionally, encouraging students to observe real-

life phenomena at home and engage in decision-making through problem-based scenarios mirrors authentic scientific inquiry, making learning more meaningful and reflective of real-world science. Instructional innovations such as laboratory-based teaching play a significant role in fostering learners' logical understanding of scientific concepts and their application in real-life contexts. Teachers highlighted that these innovative strategies not only sharpen learners' observation skills but also deepen content knowledge and stimulate curiosity in scientific exploration. Engaging learners in hands-on experiments was seen as highly effective in nurturing Science Process Skills and encouraging ac-

tive participation in science learning. These experiences align with the current study, emphasizing how science teachers leverage instructional innovations to enhance inquiry-based learning despite prevailing challenges (Mulyeni et al., 2019). Teachers recognize that innovative approaches like conducting science experiments and interactive activities are vital in realizing the learning goals set by the Science curriculum. They emphasized that the laboratory functions as a central setting where learners can translate abstract concepts into real-world practice, making it a key element in cultivating Science Process Skills. Teachers noted that sufficient access to laboratory tools and materials is crucial for facilitating meaningful engagement and achieving targeted science learning goals. These insights support the current study by illustrating how science educators utilize innovative, practice-based strategies to enhance inquiry skills, despite limitations in resources (Mushani, 2021). In addition, the study of Noroña (2021) aligns closely with the current study, as both emphasize the importance of resource optimization in enhancing science education. Teachers suggested that a laboratory resource management system would significantly improve the accessibility and use of scientific tools, providing more opportunities for hands-on learning and

the development of Science Process Skills. Additionally, the proposal for an intervention program aimed at strengthening learners' mastery of integrated Science Process Skills echoes the current study's focus on how instructional innovations can help teachers overcome resource limitations. These insights reinforce the idea that strategic interventions are key to advancing learners' inquiry abilities despite existing challenges. Moreover, drawing from the experiences of teachers in enhancing learners' Science Process Skills, laboratory resources were highlighted as essential in enriching the learning environment and deepening students' understanding of scientific principles. These resources created valuable opportunities for learners to actively engage in scientific inquiry, thereby improving their grasp and application of Science Process Skills. Teachers also noted that laboratory settings promoted collaborative learning, where students could work in small groups to explore and investigate scientific concepts through hands-on experiences. These insights are closely aligned with the current study, which explores how science teachers use instructional innovations, such as laboratory-based activities, to overcome challenges and foster inquiry-based learning among learners (Mamman et al., 2018).

3.1.3. Professional Challenges—Science teachers face various professional challenges that significantly impact their ability to effectively develop learners' science process skills through the scientific inquiry approach. Limited time in the class schedule, combined with the pressure to complete modules, often forces teachers to reduce or skip hands-on activities essential for inquiry-based learning. Difficulties in assessing individual student participation during experiments and managing classroom dynamics also hinder meaningful engagement in the scientific process. Despite the overwhelming workload and the need for more training,

many teachers persist in their efforts, driven by their commitment to providing quality science education for their students. Focus on professional challenges reveals that addressing the limitations in laboratory resources is crucial for ensuring high-quality education for all learners. In secondary education, teachers noted that such constraints often prevent learners from fully participating in hands-on activities that are essential for developing their Science Process Skills. Their experiences indicated that overcoming these resource limitations is critical to helping learners effectively acquire and apply scientific inquiry techniques. This resonates with the cur-

rent study, where science teachers' experiences also reflect how professional challenges, particularly resource gaps, shape their efforts to enhance learners' inquiry skills and address the constraints they face in providing effective science education (Ma et al., 2019). Teachers emphasized that active involvement and participation of learners are crucial for achieving meaningful learning, particularly within the realm of Science education. They observed that hands-on activities were particularly effective in developing learners' Science Process Skills—such as observing, hypothesizing, experimenting, and analyzing. The integration of simulations and laboratory resources significantly facilitated this process, allowing learners to engage with scientific concepts in a more dynamic and practical way. These findings resonate with the current study, where science teachers share how professional challenges, particularly the limitations in resources, influence their ability to implement such engaging, inquiry-based methods and enhance learners' scientific skills (Panoy, 2018). The impact of professional challenges, such as limited emphasis on science laboratories, is evident in many public schools, where issues like a shortage of lab spaces, insufficient materials, inadequate training for Science teachers,

and concerns over safety during experiments persist. These challenges hinder the effective implementation of hands-on learning, which is essential for the development of Science Process Skills among learners. Teachers shared that these constraints prevent learners from fully engaging in practical activities that could enhance their understanding of scientific concepts. This connects to the current study, where science teachers' experiences reflect how similar professional challenges influence their ability to foster inquiry-based learning and support the development of students' scientific skills (Maranan, 2019). Based on the interview responses from science teachers, three key themes emerged: resource limitations, instructional innovations, and professional challenges. The Resource Limitations theme highlights the difficulties teachers face in securing sufficient tools and materials to effectively teach science. Many educators experience a lack of appropriate laboratory equipment, instructional resources, and even basic supplies, which limits their ability to conduct hands-on experiments and provide practical learning experiences. These constraints hinder the development of learners' science process skills, making it challenging to engage students in scientific inquiry.

3.2. Distinct Category of Science Laboratory Resources that are Useful to Explore Scientific Inquiry—The three themes—digital simulations, low-cost materials, and traditional equipment—highlight the diverse strategies secondary school science teachers employ to enhance learners' scientific inquiry skills despite varying resource availability. Digital simulations offer interactive experiences that bring abstract concepts to life, making science more accessible even without a physical lab. Low-cost materials, like household items, demonstrate that engaging and effective experiments don't always require expensive resources, foster-

ing creativity and resourcefulness among both teachers and students. Meanwhile, traditional equipment, though often outdated, still plays a crucial role in developing learners' scientific skills, providing them with hands-on experience that boosts their confidence and understanding of scientific concepts. Secondary schools Science teachers utilize a combination of digital simulations, low-cost materials, and traditional equipment to enhance learners' engagement and understanding of scientific inquiry. Digital simulations, particularly those from platforms like PhET, offer an interactive approach that helps visualize complex processes, making them more

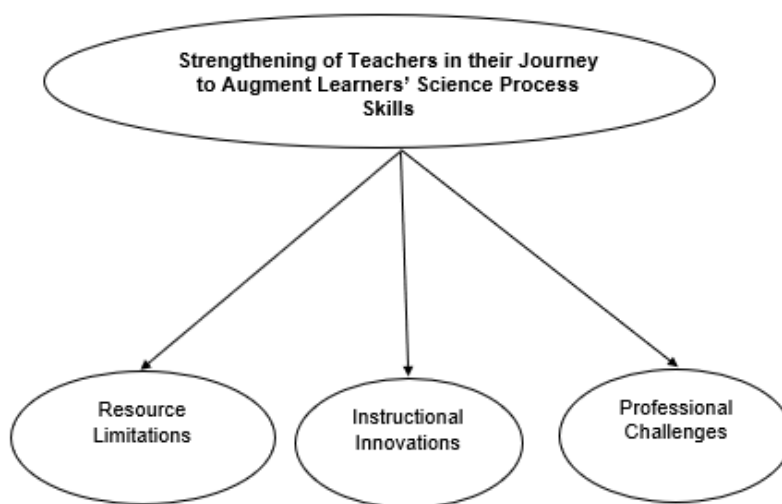


Fig. 3. Emerging Themes on the Experiences of Teachers in their Journey to Augment Learners' Science Process Skills

accessible to learners. Teachers also maximize low-cost materials, turning everyday items into valuable teaching tools, which not only reduces costs but also fosters resourcefulness and creativity in learners. Despite limited resources,

traditional lab equipment remains vital in providing hands-on experiences that help learners develop essential science process skills, reinforcing the connection between theory and practical application.

3.2.1. Digital Simulations—The theme of digital simulations emerged as a powerful tool for enhancing learners' understanding of scientific concepts, especially when physical lab resources are limited. Teachers highlighted the effectiveness of interactive platforms like PhET and DepEd Commons, which allow learners to explore cause and effect in real-time and visualize abstract concepts, such as photosynthesis, through animation. Virtual experiments projected in class further support learners' comprehension by providing visual representations of microscopic processes. However, the success of these digital tools is contingent on having reliable internet access and projectors, which can be a challenge in some schools, limiting the full potential of digital simulations as a resource for scientific inquiry. Digital simulations, when combined with specific science laboratory tools, have a fundamental role in developing

learners' Science Process Skills by promoting critical thinking and active scientific exploration. Teachers shared that resources such as digital microscopes, conductivity testers, sensor-based measuring devices, and experimental kits enhance learners' engagement in meaningful inquiry and support the development of higher-order thinking skills. This aligns with the current study, which highlights how science teachers utilize these tools to enrich inquiry-based learning and prepare learners for real-world scientific challenges (Mullis et al., 2020). Statement 2 reflects the value of hands-on, tangible learning experiences, even when using outdated equipment, in enhancing student engagement. Despite the age of the skeleton models and basic apparatus, these resources still provide a "real feel" that helps boost learners' confidence in understanding biological concepts. This underscores the importance of having ac-

cess to physical materials, as they foster curiosity and facilitate deeper learning, even in less-than-ideal conditions. Integrating digital simulations with key laboratory tools provides learners with dynamic opportunities to practice scientific inquiry while developing essential process skills and attitudes. Teachers noted that instruments like digital microscopes, test kits, magnifying lenses, and balances enable learners to ask meaningful questions, test their ideas, and interpret findings—skills that extend beyond the classroom. This supports the current study’s focus on how science teachers effectively utilize specific lab resources alongside simulations to cultivate inquiry-based learning and equip learners with transferable problem-solving abil-

ities (Sideri Skoumios, 2021). Moreover, the availability of suitable science laboratory tools significantly enhances learners’ ability to develop Science Process Skills through direct involvement in scientific investigations. Teachers shared that equipment such as test tubes, beakers, thermometers, microscopes, and digital data loggers allows learners to gather, examine, and interpret experimental data, thereby deepening their understanding of scientific concepts. This aligns with the current study, where science teachers highlighted how combining these physical resources with digital simulations strengthens learners’ inquiry skills and promotes critical thinking throughout the scientific process (Maranan, 2019).

3.2.2. Low-cost Materials—The theme of low-cost materials emerged as an effective strategy for making science education more accessible and engaging, even with limited resources. Teachers emphasized using everyday items like bottle caps, straws, rice, beans, and flour to conduct experiments, demonstrating that science doesn’t have to be expensive to be impactful. By substituting real chemicals with safe alternatives like vinegar and baking soda, teachers created fun and safe learning experiences for learners. The teachers also encouraged resourcefulness by turning material scavenger hunts into engaging activities, which helped learners become more involved in their scientific inquiry while fostering the concept that scientific notion can be explored all around them. The ultimate aim of science education is to equip learners with practical skills that they can apply in real-life situations, shaping their personal, social, and global experiences. Teachers observed that low-cost laboratory tools, such as pH meters, measuring cylinders, circuit kits, and data collection instruments, are essential in helping learners develop and apply Science Process Skills through hands-on experimentation.

This relates to the current study, where science teachers emphasized the value of affordable materials in promoting scientific inquiry, problem-solving, and critical thinking (Khan Vanaja, 2019). Low-cost materials, such as simple microscopes, measuring instruments, reaction kits, and observation charts, are essential in facilitating the development of Science Process Skills (SPS) among learners. Teachers emphasized that these affordable resources allow learners to engage in scientific inquiry and apply their skills in both local and global contexts. This is consistent with the current study, which highlights how science teachers effectively use low-cost materials to promote inquiry-based learning and strengthen learners’ scientific reasoning (Ekici Erdem, 2020). Science Process Skills should be integrated into lesson planning as a core aspect of learning, rather than being treated separately from scientific concepts. Teachers noted that low-cost laboratory materials such as specimen slides, thermometers, density kits, and experimental setups enable learners to connect theoretical knowledge with practical application, enhancing their understanding. This supports the current study, where science teachers empha-

sized the significance of affordable resources in promoting hands-on, inquiry-based learning and fostering critical thinking skills (Martiningsih et al., 2019).

3.2.3. Traditional Equipment—Traditional equipment, despite being old or limited, plays a crucial role in fostering scientific inquiry and hands-on learning. Teachers emphasized the value of basic tools like microscopes, thermometers, and test tubes in conducting experiments, with some noting that learners find the experience of using them, such as observing cells under a microscope, truly magical. Proper lab glassware like beakers and pipettes not only aids in experiments but also boosts learners' confidence, making them feel like "real scientists." While the equipment may be scarce and fragile, teachers ensure they make the most of what they have, underscoring the importance of precision with tools like balances and graduated cylinders to instill a deeper understanding of scientific accuracy. Science education extends beyond just acquiring scientific knowledge; it also involves cultivating Science Process Skills and scientific attitudes, which are vital for effective problem-solving and inquiry. Teachers observed that when learners engage with laboratory tools such as balances, magnifying lenses, test kits, and digital microscopes, they are better equipped to ask questions, test hypotheses, and draw conclusions. This supports the current study, where science teachers highlighted the value of traditional equipment in enriching scientific inquiry

and enhancing critical thinking skills applicable in everyday contexts (Sideri Skoumios, 2021). Essential laboratory tools such as beakers, test tubes, thermometers, microscopes, and digital data loggers play a key role in enhancing learners' Science Process Skills by allowing them to actively participate in experiments and scientific investigations. Teachers shared that these traditional equipment pieces help learners collect, interpret, and analyze data more effectively, encouraging critical thinking and a deeper grasp of scientific concepts. This aligns with the current study, where science teachers highlighted the value of using standard laboratory resources to promote inquiry-based learning and strengthen scientific reasoning among learners (Maranan, 2019). Traditional equipment such as microscopes, measuring tools, chemical kits, and manual lab simulations play a vital role in facilitating learners' engagement in scientific exploration and inquiry-based activities. Teachers shared that access to these laboratory resources enables learners to better investigate scientific concepts, apply process skills, and develop critical thinking through hands-on experiences. This reflects the current study's emphasis on how science teachers incorporate conventional lab tools to strengthen learners' Science Process Skills and promote meaningful inquiry learning (Tanti et al., 2020)

3.3. Reflection from the Findings of the Study—The journey of science teachers in enhancing learners' science process skills through the scientific inquiry approach revealed meaningful insights. It highlighted how empowered pedagogy, systemic gaps, and intentional skill acquisition significantly shape the way learners develop essential scientific abilities. These

elements collectively influence how effectively learners engage in and succeed with scientific inquiry. Together, these three themes illustrate how empowered teaching practices, recognition of systemic challenges, and intentional skill-building efforts are vital to enhancing learners' science process skills. By addressing both teacher and learner needs and refining instruc-

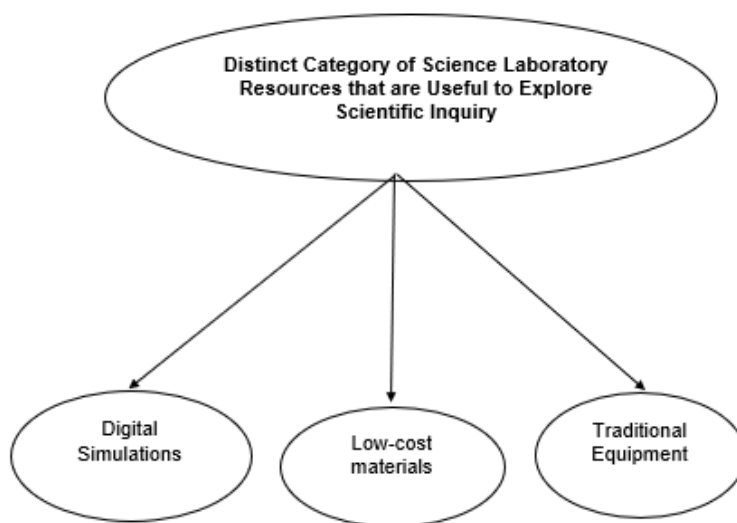


Fig. 4. Emerging Themes on the Specific Type of Science Laboratory Resources that are Useful to Explore Scientific Inquiry

tional approaches, science educators can more effectively guide learners through the processes of scientific inquiry. This collective insight highlights the transformative impact of inquiry-based instruction in fostering deeper understand-

ing and curiosity in science. Ultimately, such efforts contribute to the holistic development of learners as capable and critical scientific thinkers.

3.3.1. Empowered Pedagogy—Science teachers emphasized the importance of empowered pedagogy in cultivating learners' science process skills through the scientific inquiry approach. Teachers who felt confident and supported in their roles were more effective in designing inquiry-based activities that encouraged learners to observe, hypothesize, experiment, and analyze. This empowerment stemmed from professional development, autonomy in instructional design, and a supportive teaching environment. Such conditions enabled teachers to innovate and adapt strategies that directly addressed learners' needs. Empowered pedagogy, which emphasizes active, hands-on learning, plays a key role in helping students integrate their cognitive, practical, and social skills to develop Science Process Skills. Teachers highlighted that laboratory resources such as analytical balances, chemical reaction

kits, magnifying lenses, and experimental tools are vital in allowing learners to combine their knowledge, skills, and attitudes, which enables them to conduct experiments and observe natural phenomena. This approach aligns with the current study, where science teachers emphasized the importance of empowered pedagogy in fostering critical thinking and the practical application of scientific inquiry to augment learners' Science Process Skills (Sulistri, 2019). Further, the goal of science education is to equip learners with practical skills that they can apply in real-world contexts, impacting their personal, social, and global lives. Teachers emphasized that laboratory resources such as pH meters, measuring cylinders, circuit kits, and data collection tools are crucial for helping students develop and apply Science Process Skills, allowing them to engage in hands-on investigations. This aligns with the current

study, where science teachers highlighted how empowering pedagogy through active, inquiry-based learning enhances learners' ability to think critically, solve problems, and engage effectively in scientific exploration (Khan Vanaja, 2019). Furthermore, Fostering an active learning environment through hands-on experiences is crucial for developing essential aspects of science education, such as scientific knowledge, Science Process Skills (SPS), and scientific attitudes. Teachers emphasized that providing

learners with laboratory resources like microscopes, measuring instruments, reaction kits, and observation charts significantly enhances their ability to engage in scientific inquiry. This aligns with the current study, where science teachers highlighted that by incorporating such tools and approaches into their teaching, they empower learners to actively explore and apply scientific concepts, thereby strengthening their Science Process Skills in a variety of contexts (Ekici Erdem, 2020).

3.3.2. Systemic Gaps—Another theme that emerged was the presence of systemic gaps that hindered the full implementation of scientific inquiry. Teachers noted challenges such as lack of laboratory resources, large class sizes, and limited instructional time as barriers to consistent hands-on investigation. These institutional and logistical constraints often limited opportunities for learners to engage in authentic inquiry experiences. Addressing these systemic gaps is essential to ensuring that learners can fully participate in meaningful scientific exploration. The lack of sufficient science laboratory facilities, equipment, and instructional resources in many public schools in the Philippines presents a significant barrier to effective science education, as noted in the TIMSS and 2018 PISA assessments. As a result, science teachers often face the challenge of forgoing crucial laboratory activities, especially when it is not possible to improvise with available materials. These systemic gaps in resources impede learners from fully developing their Science Process Skills, emphasizing the need for systemic improvements to overcome such limitations and provide better support for science education (Hadji Abas Marasigan, 2020). Moreover, the systemic gaps in science education, such as the insufficient number of laboratory spaces, lack of adequate materials, limited teacher training, and safety concerns during experiments, cre-

ate substantial challenges for effective teaching and learning. These issues significantly hinder the implementation of hands-on learning experiences, preventing learners from fully developing their Science Process Skills. Resolving these gaps is essential to provide the necessary resources and support for students to engage in scientific inquiry and cultivate critical thinking abilities (Maranan, 2019). Nevertheless, Addressing the limitations in laboratory resources is crucial for providing quality science education, as these shortages prevent learners from engaging fully in activities that develop their Science Process Skills. Teachers highlighted that the lack of necessary tools and materials often restricts students from participating in hands-on experiments, which are vital for fostering their scientific inquiry abilities. Overcoming these challenges is essential to ensure that learners have the opportunity to effectively apply and enhance their skills in science (Ma et al., 2019). **Skill Acquisition.** The third major theme centered on skill acquisition; particularly how structured inquiry supports the gradual development of science process skills. Teachers observed that when learners are consistently engaged in inquiry tasks—such as data collection, interpretation, and drawing evidence-based conclusions—they become more confident and independent thinkers. Repetition and scaffolding within inquiry-based lessons helped learners in-

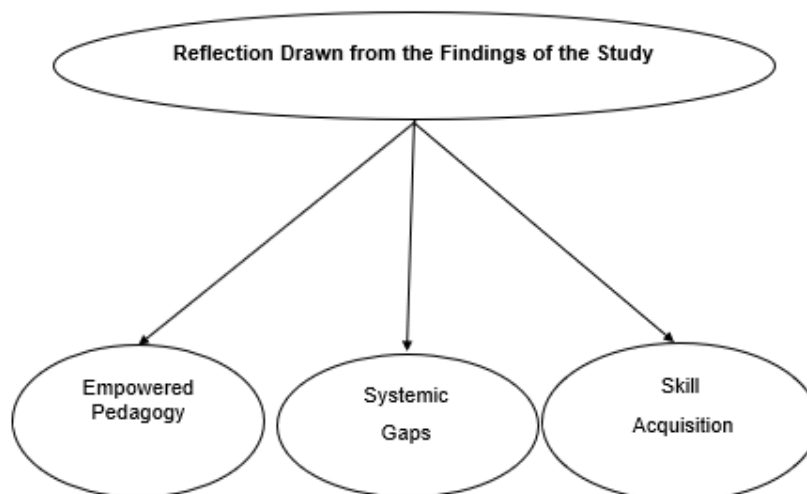


Fig. 5. Emerging Themes on the Insights Drawn from the Findings of the Study

ternalize core scientific practices. Over time, this led to noticeable improvement in learners' critical thinking and problem-solving abilities. Skill acquisition is crucial for learners to effectively engage with and achieve the goals of the Science curriculum. Teachers emphasized that the science laboratory is a central space where students can translate theoretical knowledge into hands-on experience, fostering the development of Science Process Skills. Adequate laboratory resources are essential in providing learners with the opportunities needed to deepen their understanding and successfully engage in scientific inquiry (Mushani, 2021). The development of essential science skills is crucial for learners to effectively understand and apply scientific concepts in real-life situations. According to teachers, laboratory-based learning is a vital component of science education as it not only cultivates observational skills but also deepens students' understanding while piquing their curiosity for scientific exploration. When students actively engage in hands-on activities, it significantly enhances their Science Process Skills, fostering a more dynamic and interactive approach to learning science (Mulyeni et al., 2019). Based on the figure above, three themes emerged from the responses of the participants with regards to their insights derived from their journey to augment learners' science process skills by exploring scientific inquiry approach which were: empowered pedagogy, systemic gaps and skill acquisition. Science teachers expressed that cultivating a sense of empowerment in pedagogy was vital in facilitating learners' engagement with scientific inquiry. When educators were provided with autonomy, professional support, and access to inquiry-based teaching strategies, they were more confident in guiding learners through hands-on scientific exploration. This sense of ownership enabled teachers to align their instructional methods with the real-world processes of science, fostering an skills. Another key insight revolved around the presence of structural and institutional challenges that hindered the full realization of inquiry-based learning.

4. Implications and Future Directions

In this chapter, I present a summary of the study by drawing from its findings to explore the implications and suggest future directions. The primary aim of this research was to examine the strategies employed by teachers to enhance learners' science process skills, the challenges encountered in doing so, and the deeper insights gained through their professional practice.

4.1. Findings—To achieve these objectives, I utilized a qualitative phenomenological approach, applying thematic analysis in accordance with Creswell's (2020) recommendations. Open-ended interviews were conducted to elicit genuine and in-depth reflections from junior high and senior high school Science teacher-participants. This approach allowed Science teachers to articulate their lived experiences in fostering scientific inquiry within the realities of public-school settings towards learners' Science process skills. The thematic analysis revealed several key findings. The experiences of teachers in augmenting learners' Science process skills were shaped by resource limitations, instructional innovations, and professional challenges. Despite these hurdles, teachers remained committed to inquiry-based teaching through innovative approaches such as low-cost experimentation, use of digital simulations, and contextualized real-life tasks. Likewise, in response to challenges encountered, teachers employed adaptive strategies including resource improvisation, peer collaboration, and community and parental engagement. These practices enabled them to sustain hands-on learning even in resource-constrained environments. Science laboratory resources play a crucial role in fostering scientific inquiry, especially when they are accessible, creative, and contextually adapted. Digital simulations such as PhET

or Physics Education Technology and DepEd Commons modules help visualize abstract concepts, offering students virtual lab experiences when physical tools are unavailable. Teachers also maximize low-cost and improvised materials like bottle caps, vinegar, and baking soda, proving that effective science learning can happen with everyday items. Meanwhile, traditional lab equipment—though often limited or outdated—still provides essential hands-on experiences that build precision, confidence, and authentic engagement among learners. The insights and reflections gathered from the study emphasize the growing recognition among teachers of the need to foster teaching flexibility, build learner-centered classrooms, and promote process-oriented instruction. Teachers also acknowledged the value of enhancing both students' and their own scientific thinking, underscoring the mutual growth that takes place when inquiry becomes a shared journey between learner and facilitator. Ultimately, this study highlights the crucial role of professional resilience, instructional creativity, and systemic support in strengthening science education. It calls for continuous professional development in inquiry-based pedagogy, better access to instructional tools, and more inclusive policies that prioritize both scientific exploration and critical thinking development in today's classrooms.

4.2. Implications—The results of the analysis revealed significant insights into how teachers develop and support learners' science process skills through inquiry-based instruction. From the responses of participants, three key

themes emerged: offering flexible inquiry opportunities, utilizing science-enhancing tools and resources, and sustaining learner engagement through hands-on experiences. Offering flexible inquiry opportunities reflects teachers'

commitment to adapting instruction based on student readiness, interest, and context. Educators allow students to approach scientific problems through various pathways—such as real-life observations, household-based experiments, or open-ended tasks that encourage questioning and exploration. This flexibility supports the development of core process skills like hypothesizing, observing, experimenting, and drawing conclusions, regardless of resource availability. Utilizing science-enhancing tools and resources refers to the integration of both digital and physical materials that enable meaningful inquiry. Teachers maximize digital simulations, animations, and multimedia content to visualize concepts like molecular movement or photosynthesis. At the same time, they improvise with low-cost materials—such as vinegar, baking soda, recycled bottles, and locally available items—to carry out scientific investigations. Even with limited lab equipment, tools like microscopes, test tubes, and thermometers are used to en-

rich observational and measurement skills critical to science learning. Sustaining learner engagement through hands-on experiences emphasizes the importance of maintaining curiosity and participation in science activities. Teachers engage students through collaborative group experiments, reflective science journaling, inquiry challenges, and real-world applications of scientific principles. These approaches allow learners to actively explore, test, and interpret findings—promoting deeper understanding and retention of science process skills. In summary, the study highlights that teachers play an essential role in promoting scientific inquiry by creating dynamic, adaptable, and resourceful learning environments. Through innovation, resilience, and thoughtful planning, educators continue to inspire students to think critically, explore independently, and develop the confidence to act as young scientists in and beyond the classroom.

4.3. Future Directions—Based on the findings of this study, it is essential that the insights gained be shared with and acted upon by the key stakeholders for whom this research was intended. These future directions aim to reinforce the development of science process skills in classrooms and strengthen the inquiry-based approach in science education. Learners For learners, enhancing science process skills opens doors to deeper understanding and lifelong curiosity. Encouraging students to ask questions, make predictions, and carry out simple investigations can develop critical thinking and build confidence in learning. By actively engaging in hands-on activities and real-world observations, learners gain not just content knowledge, but the ability to think like scientists. Moving forward, more opportunities should be provided for students to lead inquiries and reflect on their scientific processes. Science Teachers Science teach-

ers play a central role in shaping inquiry-driven classrooms. Future efforts must focus on equipping teachers with strategies and support to foster process skills despite resource limitations. By integrating low-cost experimentation, peer collaboration, and real-life applications, educators can create learning environments that promote curiosity and exploration. Continuous professional development in inquiry-based methods, classroom management during lab work, and assessment of process skills will empower teachers to confidently guide students through scientific discovery. Parents Parents serve as key partners in promoting scientific inquiry beyond the classroom. Supporting students in simple at-home investigations—such as observing plant growth, tracking weather patterns, or experimenting with household materials—can reinforce science process skills. Schools should engage parents through orientations and com-

munication platforms that explain how they can nurture inquiry at home, especially in communities with limited school-based resources. With their encouragement, learners can become more inquisitive and self-motivated. School Administrators School administrators have a vital role in enabling inquiry-based science teaching by providing access to basic laboratory tools, supporting improvisation, and allocating time for science experimentation. Prioritizing science process skills in the school improvement plans and recognizing inquiry-based achievements can help institutionalize these practices. Administrators should also promote collaboration among science teachers and support initiatives such as science fairs, practical assessment workshops, and instructional material development. Policy Makers Policymakers are encouraged to recognize the importance of science process skills in cultivating critical thinking and problem-solving abilities in learners. Educational policies should ensure equitable access to essential science resources and train-

ing programs for teachers. Budget allocations must support the provision of laboratory materials, development of low-cost instructional kits, and teacher upskilling on inquiry-based pedagogies. A stronger focus on scientific inquiry in curriculum standards will contribute to a more analytical and research-oriented generation of learners. Future Researchers Future researchers may expand on this study by exploring how inquiry-based instruction impacts student learning across different grade levels and contexts. Investigating the long-term development of science process skills or the effectiveness of specific teaching interventions can offer valuable insights. Research could also examine the systemic challenges faced by science teachers and identify scalable solutions for resource-poor settings. By building on this study's findings, future research can contribute to a deeper understanding of how to make inquiry-based science education more inclusive, effective, and sustainable.

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