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Inquiry-Based Learning: Perspectives of Elementary Teachers

Mariecho L. Miasero*
Public School Teacher, Department of Education, New Corella, Davao del Norte, Philippines

Abstract—The purpose of this phenomenological study was to explore the experiences of elementary teachers on inquiry-based learning in New Corella District, Division of Davao del Norte. This also probed their coping mechanisms from the challenges they encountered, and their insights drawn from the findings of this study. Qualitative–phenomenological study was employed in exploring the views of the ten (10) elementary teachers of which primary instrument of data gathering was through in- depth interview. Major findings revealed that in exploring the experiences of teachers in inquiry-based learning in science, the major themes were professional development and support, student engagement and motivation, and assessment and accountability. Further, the challenges inherent in implementing inquiry-based learning in science classrooms necessitated the development of effective coping mechanisms by teachers. To sum it up, the major themes on the participants' coping mechanisms were differentiation and personalization, technology integration, and community engagement and real-world connections. Finally, the three major themes relative to the perceptions of the participants were shift in student engagement and interest, challenges and opportunities for professional growth, and impact on deep learning and critical thinking. The perceptions of teachers using inquiry-based learning in science unveiled a rich tapestry of insights that shaped their understanding of this pedagogical approach. The implications of research on inquiry-based learning in science education extended far beyond the confines of individual classrooms, carrying significant relevance for educational policy, professional development initiatives, and the broader landscape of science education. The findings from such research had the potential to inform curriculum design, offering insights into effective strategies for integrating inquiry-based approaches into existing frameworks.

***Index Terms*—inquiry-based learning, elementary teachers, Davao del Norte, Philippines.**

1. Introduction

In recent years, there has been a growing emphasis on inquiry-based learning in science education at the elementary level. Inquiry-based learning is an educational approach that encourages students to actively engage in the learning process by posing questions, conducting investigations, and seeking answers. This approach is considered highly effective in promoting deeper understanding, critical thinking, and problem-solving skills among students. As a result, many educators have adopted inquiry-based strategies to enhance science instruction in elementary classrooms.

In the United States, in their 2017 study, Quigley and colleagues examined four significant hurdles that teachers encounter while incorporating inquiry-based teaching into their classrooms. These challenges encompass assessing the caliber of inquiry, leveraging discourse to enhance inquiry, striving to deliver subject matter via inquiry techniques, and acquiring the skills to efficiently manage an inquiry-based classroom. Similarly, in Dubai, findings of Gholam (2019) indicated that prospective teachers perceived the "school system" as an impediment to the implementation of inquiry-based learning (IBL) in their classrooms. Additionally, insights from responses to open-ended questions were categorized into two principal themes: IBL fosters a culture of profound and transferable learning, as well as enhances student engagement; and IBL enables differentiation and empowers student voice and choice. To fully leverage this innovative, student-centered approach, it is crucial for IBL to be highly esteemed at all educational levels, commencing from the early stages and spanning across all academic disciplines. Embedding IBL in daily school curricula is essential to ensure an interactive learning journey that encourages student inquiry, deep learning, and motivated, engaged learners.

Further, exploring cross-curricular integration and its impact on students' holistic development is a significant research inquiry. Guido (2017) investigated inquiry from the vantage point of both students and teachers. He elucidated that when seen through the eyes of a student, inquiry-based learning centers on the exploration of open-ended questions or issues. Moreover, a research investigation conducted by Gu and colleagues in 2015 revealed that students engaged in inquiry-based approaches have indicated increased levels of academic self-assurance, demonstrated a greater tendency to address and overcome conflicts, displayed reduced apprehension regarding taking risks, and exhibited a greater inclination to persistently explore alternative avenues for achieving success following failures.

In the Philippines, the adoption of inquiry-based teaching has been actively promoted alongside recent curriculum reforms. Extensive efforts have been made to provide comprehensive teacher professional development, aiming to properly introduce and demonstrate the advantages of inquiry-based teaching. Notwithstanding these endeavors, a significant gap persists in the successful integration of inquiry-based teaching within

*Corresponding author: mm.leopardas@gmail.com

classrooms. Lesson study, a professional development model originating from Japan, has gained popularity among education experts due to its recognized ability to establish sustainable, collaborative, and reflective professional growth for practicing teachers. This study utilized the lesson study framework to identify three key challenges in implementing inquiry-based teaching within elementary school science education in the Philippines. These challenges include a deficiency in support, training, and the availability of inquiry-based teaching materials; an excessive focus on evaluating content learning as opposed to learning derived from inquiry; and the inherent difficulties and time-consuming nature of inquiry-based approaches (Gutierez, 2015).

In New Corella District, Division of Davao del Norte, several typical issues associated with inquiry-based learning involve challenges of teachers such as students' struggles in identifying their own achievements, addressing their limited abilities in collaborative teamwork, and surmounting their organizational difficulties in managing their tasks. The assertion regarding inquiry-based learning does not guarantee that it ensures learning, but rather emphasizes that learning derived from narrow experiences will always have limitations, regardless of the approach used. Nevertheless, each of the suggested methods for broadening experiences presents its own challenges, and there are no assurances of their effectiveness.

While inquiry-based learning is typically associated with science, there is limited research on how teachers integrate it with other subjects in the elementary curriculum. Addressing these research gaps can contribute to a more comprehensive understanding of the experiences of teachers in inquiry-based learning and enhance the effectiveness of science education in elementary schools.

The research study on the experiences of teachers in using inquiry-based learning holds significant social relevance due to several important factors. A primary social relevance of this research is its potential to enhance science education at the elementary level. By understanding the challenges and successes teachers face in implementing inquiry-based learning, the study can contribute to the development of more effective science instruction methods. This, in turn, can lead to a better-educated and more scientifically literate citizenry. Also, inquiry-based learning promotes critical thinking, problem-solving, and scientific reasoning among students. These skills are not only crucial for success in the classroom but also for preparing students to tackle real-world challenges. Improved science education helps individuals make informed decisions about important issues, such as healthcare, climate change, and technology.

By investigating these aspects, the research aims to provide insights into the complex landscape of implementing inquiry-based learning in elementary education. It also seeks to contribute to the ongoing discourse about effective pedagogical strategies in science education and how they impact both teachers and students. Understanding the experiences of teachers in this context can inform the development of more targeted professional development programs and curriculum enhancements to support the integration of inquiry-based learning in elementary science classrooms.

2. Purpose of the Study

The purpose of this phenomenological study was to explore the experiences of elementary teachers on inquiry-based learning in New Corella District, Division of Davao del Norte. This also probed their coping mechanisms from the challenges they encountered, and their insights drawn from the findings of this study.

At this stage of research, the experiences of teachers were generally defined as their learning and difficult experiences in implementing inquiry-based learning in teaching science. Inquiry-based learning is of paramount importance as it cultivated essential skills such as critical thinking, problem-solving, and scientific inquiry. It empowered students to become active participants in their learning process, encouraging them to ask questions, investigate, and seek answers. This approach not only deepened their understanding of scientific concepts but also fostered a lifelong curiosity and passion for the subject. Furthermore, by engaging in hands-on experiments and collaborative activities, students developed practical scientific skills and gained a better appreciation of the real-world applications of science, ultimately preparing them to address complex challenges and contribute to advancements in science and technology.

Research Questions:

This study aimed to explore the experiences of elementary teachers on inquiry-based learning in New Corella District, Division of Davao del Norte. Specifically, this study sought to answer the following research questions:

1. What are the experiences of teachers in using inquiry-based learning in science?
2. How do the teachers cope with the challenges they encountered in using inquiry-based learning in science?
3. What are the perceptions of teachers in using inquiry-based learning in science?

3. Methods

This study employed a qualitative research methodology, which constituted an investigative approach focused on the examination and understanding of complex phenomena by gathering and scrutinizing non-numerical data. Typically, qualitative research was utilized to gain insights into individuals' behaviors, attitudes, beliefs, and experiences within their natural settings. It proved invaluable in investigating intricate issues and promoting a deeper understanding of human behavior and the societal domain. It served as a complementary approach to quantitative research, which concentrated on numerical data and statistical analysis, by providing a holistic and context-specific perspective on phenomena (Creswell, 2015).

The eligibility requirements for participants were as follows: To take part in this study, individuals should have satisfied the following conditions: (a) possessed at least one year of teaching experience as a Teacher I in public elementary schools located

within the New Corella District, Division of Davao del Norte; (b) currently held teaching assignments as science teachers in the elementary level within the district; (c) had encountered challenges in using inquiry-based learning in science; and (d) were either male or female educators. Furthermore, a total of ten participants were selected for in-depth interviews, a sample size deemed adequate for the purpose of elucidating the ability to identify and develop thematic components.

Data analysis in qualitative research was a complex and interpretive procedure that held a central role in deriving meaningful insights from the amassed data. Unlike quantitative research, which relied on numerical data and statistical methods, qualitative data analysis was focused on comprehending the intricacies of human experiences, behaviors, and viewpoints. It entailed the methodical scrutiny of textual or visual data, such as interview transcripts, observations, or documents, to uncover patterns, themes, and relationships. The researcher employed diverse strategies for data analysis, including content analysis and thematic analysis.

Throughout this process, the researcher maintained a reflective posture, acknowledging their personal biases and preconceptions, which could influence interpretation. The ultimate objective of qualitative data analysis was to produce comprehensive findings grounded in context that enriched the comprehension of the research subject and provided a foundation for theory development or policy recommendations. It was an iterative and dynamic procedure that demanded meticulous attention to detail, a dedication to ethical principles, and a readiness to deeply explore the data to reveal its underlying significance (Akinyode & Khan, 2018). In this study, I highlighted the use of data coding, thematic analysis, and environmental triangulation.

4. Results and Discussions

A. Experiences of Teachers in Using Inquiry-Based Learning in Science

The experiences of teachers in using inquiry-based learning in science reveal a multifaceted landscape shaped by diverse challenges and triumphs. As educators navigate the dynamic realm of inquiry-based pedagogy, several major themes emerge, shedding light on crucial aspects that influence the effectiveness and sustainability of this instructional approach. Professional development and support emerge as a cornerstone, illustrating the pivotal role that ongoing training and collaborative networks play in enhancing teachers' confidence and competence. Student engagement and motivation stand out as vital outcomes, with teachers sharing insights on designing activities that ignite curiosity and foster a sense of ownership among learners. Additionally, the theme of assessment and accountability underscores the complex interplay between the inherently dynamic nature of inquiry-based learning and the need to meet educational standards and testing requirements. Together, these themes offer a comprehensive overview of the intricate tapestry of experiences that teachers encounter as they strive to integrate inquiry-based learning into the science classroom.

1) Professional Development and Support

One major theme in the experiences of teachers using inquiry-based learning in science is the need for adequate professional development and ongoing support. Teachers often face challenges in implementing inquiry-based approaches, including designing effective inquiry activities, managing classroom dynamics, and assessing student understanding. Access to quality professional development programs that provide guidance, resources, and opportunities for collaboration with peers can significantly impact teachers' confidence and competence in using inquiry-based methods. Additionally, ongoing support from administrators and educational institutions is crucial for sustaining the implementation of inquiry-based learning over time.

Recently implemented curricular modifications have emphasized inquiry-based teaching. Comprehensive teacher professional development has been done to present and show inquiry-based teaching's benefits. Despite these efforts, inquiry-based teaching in schools remains difficult. Japanese lesson study, a professional development methodology, is popular among education professionals because it fosters sustained, collaborative, and reflective teacher growth. This research identified three significant problems in implementing inquiry-based scientific instruction in Philippine primary schools using the lesson study framework. The lack of support, training, and inquiry-based teaching materials; an excessive focus on content learning rather than inquiry-based learning; and the inherent difficulties and time-consuming nature of inquiry-based approaches are among these challenges (Gutierez, 2015).

2) Student Engagement and Motivation

Another key theme revolves around student engagement and motivation. Teachers find that inquiry-based learning methods have the potential to significantly enhance student interest and enthusiasm for science. However, achieving this outcome requires thoughtful planning, the incorporation of real-world problems, and the creation of opportunities for students to explore and discover. Teachers often share their experiences in developing inquiry-based activities that spark curiosity and foster a sense of ownership in students. Balancing the need for structure with the flexibility for student exploration is a common challenge, and teachers reflect on strategies to maintain a positive and engaging learning environment.

Quigley and colleagues conducted a research in 2017 to investigate four major obstacles that instructors face while implementing inquiry-based teaching in their classrooms. These problems are evaluating the quality of investigation, using conversation to improve investigation, aiming to convey content using investigation methods, and developing the abilities to effectively handle a classroom that emphasizes investigation.

Gholam (2019) found that potential teachers in Dubai see the "school system" as a barrier to IBL. Responses to open-ended questions revealed two main themes: IBL promotes meaningful and transferable learning, student involvement, and differentiation and student voice and choice. This unique, student-centered approach requires IBL to be highly valued at all educational levels, from early on and throughout all

academic fields. IBL must be integrated into everyday classroom curriculum to promote student curiosity, deep learning, and motivation.

3) Assessment and Accountability

The theme of assessment and accountability is prevalent in teachers' experiences with inquiry-based learning in science. Traditional assessment methods may not align perfectly with the dynamic and student-driven nature of inquiry-based approaches. Teachers grapple with finding effective ways to assess students' understanding, skills, and the scientific process itself. Additionally, the need to meet curriculum standards and standardized testing requirements adds an extra layer of complexity. Teachers share their insights on designing authentic and meaningful assessments that capture the essence of inquiry-based learning while also addressing the demands of educational accountability. Striking a balance between fostering a deep understanding of science concepts and meeting external assessment expectations is a recurring consideration for teachers implementing inquiry-based learning.

Based on findings from global assessments, Indonesia's educational quality remains subpar. International studies, such as the Education Development Index, reveal that Indonesia remains stagnant within the medium category, particularly in the realm of science education. This observation underscores the challenges associated with science instruction. Assessments demonstrate enhanced learning outcomes in both the experimental and control groups, with improvements reaching a moderate level. The data follows a normal distribution pattern, indicating homogeneity in both groups. Additionally, the t-test reveals a significant impact associated with the utilization of guided inquiry models when compared to conventional instruction using developed tools (Rahayu et al., 2020).

Furthermore, the outcomes revealed that the adoption of inquiry-based learning led to a shift in students' roles from being primarily participatory to more constructive roles, while the traditional science curriculum did not induce any changes in their participatory roles. In addition, inquiry-based learning facilitated a transformation of students' reproductive conceptions into more constructive ones. Conversely, students in the control group did not exhibit any alterations in their reproductive conceptions (Yıldız-Feyzioglu & Demirci, 2021).

B. Coping Mechanisms of Teachers with the Challenges in Using Inquiry-Based Learning in Science

The challenges inherent in implementing inquiry-based learning in science classrooms necessitate the development of effective coping mechanisms by teachers. As educators strive to navigate the complexities associated with this pedagogical approach, several key themes emerge in their coping strategies. From adaptability and collaboration to reflective practices and technology integration, these themes collectively underscore the dynamic and multifaceted nature of teachers' responses to challenges. This exploration delves into the various coping mechanisms employed by teachers, shedding light on the ways in which they navigate obstacles, refine instructional strategies, and ultimately foster an environment conducive to the successful implementation of inquiry-based learning in the realm of science education. To sum it up, the major themes on the participants' coping mechanisms were differentiation and personalization, technology integration, and community engagement and real-world connections.

1) Differentiation and Personalization

Coping with challenges in inquiry-based learning often involves the ability to differentiate and personalize instruction. Teachers recognize that students have diverse learning styles, interests, and levels of prior knowledge. Those who successfully cope with challenges in inquiry-based learning tailor their activities to accommodate these differences. This may involve providing additional support for struggling students, offering enrichment opportunities for those who grasp concepts quickly, and adjusting the pace of inquiry activities to ensure inclusivity. By embracing differentiation and personalization, teachers address individual needs and create a more supportive learning environment.

The findings from this research indicated that the strength of the teacher-student relationship had the most significant predictive influence on science literacy (SL) and played a moderating role in the impacts of guided and open inquiry on SL. Classroom management also exhibited moderating effects for both guided and open inquiry. Moreover, this study underscored the dominant impact of open inquiry on SL in comparison to guided inquiry (Liu & Wang, 2022).

Drawing from existing literature and researchers' interests, a novel instructional model rooted in the inquiry-based 5E approach was integrated into a fresh framework centered on four essential questions ("What will I learn?", "Why will I learn?", "With what will I learn?", and "What have I learned?"). This framework was further bolstered by the incorporation of instructional technologies, featuring distinct stages with standard applications for problem-solving. The findings of this endeavor demonstrated notable improvements in the students' science achievement and the enhancement of their scientific process skills. Furthermore, this implementation effectively addressed various facets of the students' affective learning domains, including their attitudes, motivation, sense of responsibility, and values related to the learning environment (Unlu & Dokme, 2020).

2) Technology Integration

Technology integration emerges as a coping mechanism for teachers navigating challenges in inquiry-based learning. Teachers recognize the potential of educational technology to enhance the inquiry process, facilitate data collection and analysis, and provide additional resources. Those coping effectively with challenges often leverage technology tools and platforms to engage students, support virtual or remote inquiry experiences, and overcome resource limitations. Integrating technology allows teachers to creatively address challenges, providing students with new avenues for exploration and collaboration in the science classroom.

The science education field is progressively placing greater importance on the utilization of mobile applications within the framework of inquiry-based learning (IBL) to enhance students' attitudes and their grasp of scientific concepts. While there exists a substantial body of research concerning the use of

mobile apps in IBL within science education, there has been relatively insufficient emphasis on establishing connections between the features of these apps and their pedagogical benefits. The results of this investigation reveal a discernible trend of upgraded functional attributes that bolster IBL, offering valuable insights to educators seeking to enhance their use of mobile applications to facilitate students' scientific learning (Liu et al., 2021).

Advancements in technology present the potential for the integration of multimedia content through mobile devices to enhance the learning environment. While hands-on experiments hold a pivotal position in science education, there is limited understanding of how to effectively integrate multimedia learning within the context of physical experimental procedures, particularly within realistic classroom settings. Analysis through multilevel regression demonstrated that this approach results in a noteworthy reduction in extraneous cognitive load and a notable increase in conceptual knowledge. A confirmatory path analysis further established that these effects are primarily attributed to the treatment itself and are not significantly affected by teacher behavior (Becker et al., 2020).

3) Community Engagement and Real-World Connections

Coping with challenges in inquiry-based learning involves establishing connections between classroom activities and the real world. Teachers who successfully navigate challenges often incorporate community engagement and real-world applications into their inquiry-based lessons. This theme involves bringing in guest speakers, organizing field trips, or collaborating with local scientists or professionals. By contextualizing inquiry activities within the broader community and real-world scenarios, teachers provide students with meaningful contexts, fostering a deeper understanding of scientific concepts and motivating them to overcome challenges with a sense of purpose.

The evolution of educational theories, current societal requirements, and the favorable empirical discoveries in pertinent literature lend credence to the argument that inquiry-based learning (IBL) holds significant promise for educational instruction, warranting further exploration. While international research on content analysis of IBL in science education remains limited, there is a scarcity of insights regarding the overarching patterns of IBL within the landscape of science education research in Ethiopia. This study's outcomes reveal that IBL is an emerging research domain in Ethiopia, primarily implemented in primary-level science education. This research serves as a valuable resource for gaining insights into the character and status of IBL research in Ethiopia and provides valuable information for shaping the future of IBL in this context (Berie et al., 2022).

Because the reliability of indigenous knowledge concerning factual events in scientific materials is frequently questionable, it highlights the need for scientific exploration through the amalgamation of Inquiry-Based Learning (IBL) and ethnoscience. The outcomes of this integration showed substantial improvements in scientific skills and science literacy. Furthermore, the significance level of the treatment administered was 0.000, which was lower than 0.05. This indicates that the combination of IBL and ethnoscience was notably more effective in augmenting students' scientific skills and science literacy when compared to the traditional scientific approach (Hastuti et al., 2019).

C. Perceptions of Teachers in Using Inquiry-Based Learning in Science

The three major themes relative to the perceptions of the participants were shift in student engagement and interest, challenges and opportunities for professional growth, and impact on deep learning and critical thinking. The perceptions of teachers using inquiry-based learning in science unveil a rich tapestry of insights that shape their understanding of this pedagogical approach. As educators embrace the dynamic shift towards inquiry, several major themes emerge, reflecting their observations, challenges, and triumphs in the classroom. One prevalent theme revolves around the transformative impact on student engagement and interest, highlighting the profound changes teachers witness as students become more motivated and curious in the exploration of scientific concepts. Another significant theme delves into the teachers' perceptions of challenges and opportunities for professional growth, showcasing the intricate balance between the demands of inquiry-based learning and the continuous development of their instructional skills.

Finally, the theme of the impact on deep learning and critical thinking underscores the broader educational goals associated with inquiry, as teachers recognize its role in cultivating a profound understanding of scientific principles and nurturing essential critical thinking skills. Together, these themes offer a comprehensive view of how teachers perceive and navigate the landscape of inquiry-based learning in the science classroom.

1) Shift in Student Engagement and Interest

One major theme in the perceptions of teachers using inquiry-based learning in science revolves around the observed shift in student engagement and interest. Teachers often report a notable increase in students' enthusiasm for learning when exposed to inquiry-based approaches. The hands-on nature of inquiry, coupled with the exploration of real-world problems, tends to captivate students' curiosity and encourages active participation. Teachers observe a positive transformation in the classroom dynamics, with students becoming more motivated, curious, and eager to explore scientific concepts through inquiry.

Certain inquiry practices exhibited a notable and consistent positive correlation with science achievement, particularly those related to contextualizing science learning. Conversely, two of the practices that displayed negative associations, namely explaining ideas and conducting experiments, were determined to have a non-linear connection to science achievement. This was achieved by identifying the inflection point of the non-linear relationships identified in the previous model. For instance, the results indicated that students who conducted experiments in the laboratory during some lessons achieved higher scores than students who conducted experiments in all lessons. These findings, complemented by a comprehensive analysis of the individual practices and their

impact on science outcomes, provide valuable guidance to stakeholders regarding the effective utilization of inquiry-based approaches within the classroom (Cairns, 2019).

Further, inquiry-based education has garnered significant attention in both educational practice and theory due to its capacity to actively involve students and teachers in collaborative problem-solving. An analysis of the data revealed a range of teaching strategies, which varied based on their orientation (teacher-led, student-led, or a combination of both) and the different dimensions of regulation (meta-cognitive, conceptual, and social regulation). Findings indicate that crucial teacher strategies concerning metacognitive regulation encompass a focus on developing thinking skills, fostering a culture of inquiry, facilitating discourse around inquiry, and promoting an understanding of the nature of science. In conceptual regulation, the key strategies involve imparting relevant information on the research topic and emphasizing conceptual comprehension. As for social regulation, the critical strategies encompass bridging the achievement gap among students, structuring group-based learning, and emphasizing collaboration processes (Dobber et al., 2017).

2) Challenges and Opportunities for Professional Growth

Another significant theme centers on the perceptions of challenges and opportunities for professional growth among teachers using inquiry-based learning. While many educators recognize the potential benefits of inquiry, they also acknowledge the associated challenges, such as the need for extensive planning, adapting to unforeseen circumstances, and addressing varied student needs. However, teachers often perceive these challenges as opportunities for professional development and growth. Navigating the complexities of inquiry-based learning prompts teachers to refine their instructional strategies, develop new skills, and engage in ongoing learning, ultimately contributing to their overall professional advancement.

Furthermore, the results indicate that the participants' perceptions of quality and the evidence from practicum reports are in agreement with the planned quality of the model on a global scale. The approach advocates for the development of inquiry skills, diverse professional knowledge, and a transformational perspective on education (Vieira et al., 2021).

Likewise, the teachers highlighted the successful integration of Inquiry-Based Learning (IBL) and individual mentorship as key components of the Continuing Professional Development (CPD) methodology. Educators emphasized the significance of students' ability to conduct inquiries rooted in their own inquiries, which had a beneficial influence on students' curiosity and drive. Educators also recognized the significance of their own strategic planning and objective establishment. The findings suggest that teachers had a conflict between maintaining authority and surrendering authority, which might provide a difficulty (Kurtén & Henriksson, 2021).

3) Impact on Deep Learning and Critical Thinking

Teachers frequently express a perception of the profound impact of inquiry-based learning on students' deep learning and critical thinking skills. Inquiry approaches encourage students to explore concepts at a deeper level, fostering a more thorough understanding of scientific principles. Teachers observe students developing critical thinking skills as they formulate hypotheses, design experiments, and analyze results. The emphasis on inquiry-based learning is often linked to the broader goal of cultivating lifelong learners who can independently apply critical thinking skills to solve complex problems, both within and beyond the realm of science.

Inquiry is a concept employed in both educational and everyday contexts, signifying the act of searching for explanations or information through the act of asking questions (Harlen, 2013). Inquiry-based learning (IBL) is an educational approach that places students at the forefront of the learning process, empowering them to assume responsibility for their own learning by formulating, exploring, and resolving questions (Caswell & LaBrie, 2017).

Exploring cross-curricular integration and its impact on students' holistic development is a significant research inquiry. Guido (2017) investigated inquiry from the vantage point of both students and teachers. He elucidated that when seen through the eyes of a student, inquiry-based learning centers on the exploration of open-ended questions or issues.

Moreover, a research investigation conducted by Gu and colleagues in 2015 revealed that students engaged in inquiry-based approaches have indicated increased levels of academic self-assurance, demonstrated a greater tendency to address and overcome conflicts, displayed reduced apprehension regarding taking risks, and exhibited a greater inclination to persistently explore alternative avenues for achieving success following failures.

5. Implications and Future Directions

A. Implications

The implications of research on inquiry-based learning in science education extend far beyond the confines of individual classrooms, carrying significant relevance for educational policy, professional development initiatives, and the broader landscape of science education. The findings from such research have the potential to inform curriculum design, offering insights into effective strategies for integrating inquiry-based approaches into existing frameworks.

Additionally, research implications may shape teacher training programs, providing educators with the necessary tools and methodologies to successfully implement inquiry-based learning in diverse classroom settings. Moreover, understanding the impact of inquiry-based learning on student outcomes can contribute to evidence-based decision-making in educational policy, advocating for pedagogical approaches that foster critical thinking, problem-solving, and a genuine passion for scientific exploration.

The research implications, therefore, not only enhance our understanding of effective teaching practices but also have the potential to catalyze positive transformations in science education at institutional and systemic levels.

B. Future Directions of the Study

As we reflect on the current state of inquiry-based learning

in science education, it becomes evident that the path forward holds exciting prospects and challenges that warrant comprehensive investigation. Future directions of the study should focus on expanding our understanding of the diverse ways in which inquiry-based learning can be implemented across varied educational contexts, catering to the needs of different student populations. Exploring the integration of emerging technologies and innovative pedagogical approaches within inquiry-based frameworks is a promising avenue, allowing educators to leverage contemporary tools to enhance the learning experience.

Additionally, the future of inquiry-based learning research should delve deeper into the nuanced relationships between teacher preparation, professional development, and the successful implementation of inquiry strategies in the classroom. Furthermore, an exploration of the long-term effects of inquiry-based learning on students' academic and career trajectories will provide valuable insights into the sustained impact of this pedagogical approach. Overall, future studies should aim to refine and expand the knowledge base surrounding inquiry-based learning in science education, paving the way for its continued evolution and widespread efficacy in fostering a generation of scientifically literate and critically thinking individuals.

Department of Education: For the Department of Education, future directions of the study on inquiry-based learning in science education should involve the development of comprehensive guidelines and standards that endorse and support the integration of inquiry approaches into official curricula. Policymakers can collaborate with educators, researchers, and stakeholders to establish a cohesive framework that ensures consistent implementation across schools and districts.

School Administrators: School administrators should focus on fostering a culture of inquiry within their institutions, providing resources, training, and support for teachers to effectively adopt and adapt inquiry-based practices. Emphasizing the importance of inquiry in professional development initiatives and evaluating its impact on student outcomes will be critical for administrators in shaping a conducive learning environment.

Teachers: Teachers can benefit from future research that delves into practical strategies for seamless integration of inquiry-based learning into diverse classrooms. Tailored professional development programs should be designed to equip teachers with the skills to implement inquiry effectively, address potential challenges, and customize approaches to meet the unique needs of their students.

Future Researchers: Future researchers should explore the ongoing evolution of inquiry-based learning by investigating emerging trends, innovative methodologies, and the integration of technology. Longitudinal studies can assess the sustained impact of inquiry on students' academic and career trajectories, contributing valuable insights for the continuous improvement of science education.

Essentially, future directions should align efforts across these stakeholders to promote a cohesive, evidence-based, and sustainable implementation of inquiry-based learning in science education. In conclusion, the future directions of the study on inquiry-based learning in science education hold the promise of reshaping the landscape of teaching and learning in profound ways. By focusing on collaboration among the Department of Education, school administrators, teachers, and future researchers, the trajectory of inquiry-based learning research should aim for the development of comprehensive guidelines and standards at the policy level, fostering a culture of inquiry within schools, and providing teachers with the necessary tools for effective implementation. Future studies should explore innovative approaches, such as the integration of emerging technologies and personalized learning strategies, to enhance the efficacy of inquiry-based practices.

Additionally, longitudinal research tracking the long-term impact on students' academic and career paths will contribute to the continued refinement and validation of inquiry-based learning in science education. Through these concerted efforts, the future holds the potential to establish inquiry-based learning as a cornerstone of science education, equipping students with the skills, curiosity, and critical thinking abilities needed to navigate the complexities of the scientific world.

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