

Integrating Inquiry-Based Learning in the New Greek Primary Science Curriculum

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ABSTRACT

This study explores how inquiry-based learning (IBL) is incorporated into the recently implemented Greek primary science curriculum, emphasizing the vital role that IBL plays in fostering students' scientific literacy and critical thinking. The study presents a framework that enriches learning environments through hands-on, inquiry-driven methods, drawing insights from successful practices in various European educational contexts. The curriculum reforms are designed to bridge the gap between theoretical knowledge and practical application, equipping students with vital problem-solving skills for understanding complex scientific phenomena. The research underscores the essential role of continuous professional development in empowering educators to effectively implement these changes, ensuring they are confident in their teaching practices. Educators are the linchpin of this new curriculum, and their support is indispensable. The study also emphasizes the need for a customized implementation strategy that respects local cultural frameworks. This is not just a suggestion but a necessity, as it is crucial for promoting scientific inquiry. By incorporating IBL, the curriculum aims to prepare students for the challenges of a rapidly evolving world, fostering a culture of inquiry crucial for nurturing scientifically literate citizens. This approach enhances educational outcomes and encourages students to take ownership of their learning journey, promoting autonomy and personal investment in their education.

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1. INTRODUCTION

Integrating inquiry-based learning into the New Greek Primary Science Curriculum is a collaborative endeavor that requires the collective efforts of educators, policymakers, and researchers. This reform is crucial for fostering students' deeper understanding of scientific concepts. Research demonstrates that inquiry-based approaches enhance students' engagement and improve their problem-solving skills (Aceska, 2015; Smith *et al.*, 2022). Moreover, studies show that teachers who adopt inquiry-based methods report increased self-efficacy in their teaching practices and a greater capacity to connect science with other subjects (Albion & Spence, 2013; Johnson & Tawfik, 2022). Inquiry-based learning encourages students to ask questions, develop hypotheses, and conduct experiments, which aligns with the curriculum's objectives of promoting critical thinking (Williams, 2022). However, many educators face challenges in implementing these strategies effectively, often due to a lack of training and

resources (Jimenez-Aleixandre *et al.*, 2010; Kotsis, 2024a). Addressing these concerns through targeted professional development can bridge the gap between curriculum goals and classroom practices, ultimately contributing to more effective science education (Blatt-Gross, 2019; Jones, 2020). Thus, the successful integration of inquiry-based learning in Greek primary science education requires a collaborative effort among educators and policymakers to provide the necessary support and training, including the development of a customized implementation strategy that respects local cultural frameworks while promoting scientific inquiry.

In contemporary educational discourse, the significance of IBL has emerged as a pivotal strategy in fostering scientific literacy among students across various educational systems. This innovative approach allows learners to engage actively with the scientific process at hand, promoting not merely rote memorization of facts but rather encouraging a deeper understanding of scientific



concepts through hands-on exploration and meaningful inquiry. In Greece, recent reforms in the primary science curriculum have taken center stage, emphasizing the integration of IBL to better equip students with essential problem-solving and critical-thinking skills that are vital in today's rapidly evolving society (McGee, 2001). These carefully crafted reforms aim to bridge the often-overlooked gap between theoretical knowledge and practical application, thereby significantly enhancing students' ability to navigate complex scientific phenomena and fostering a more profound and lasting engagement with the material studied. The incorporation of inquiry-based methodologies within the new Greek primary science curriculum represents a paradigmatic and transformative shift in pedagogical approaches. It aligns closely with contemporary educational theories, reassuring the audience about the validity of the approach by fostering an environment prioritizing exploration, creativity, and critical thinking. This essential shift nurtures curiosity among young learners of diverse backgrounds. It cultivates an enriching environment where scientific inquiry closely mirrors real-world practices, encouraging students to think critically and creatively (Albion & Spence, 2013).

As students engage in a thorough investigation, they develop a strong sense of ownership over their learning, leading to greater motivation and individual investment in their educational journey, fostering a lifelong love of discovery. Ultimately, the transition towards inquiry-based learning in the Greek primary science curriculum holds immense potential to transform educational experiences for the better, significantly preparing students for the multifaceted challenges of the 21st century and beyond. It addresses the pressing need for scientifically literate citizens who can contribute meaningfully to society. The newly implemented Greek primary science curriculum represents a significant shift towards inquiry-based learning, emphasizing experiential engagement and problem-solving skills necessary for the 21st century.

The new curriculum aims to bridge the educational gap between primary and secondary levels by integrating contemporary scientific themes and real-world issues, such as climate change and health, into the learning experience (Kotsis *et al.*, 2023a). It seeks to cultivate critical thinking and collaboration through inquiry-driven activities, encouraging students to explore scientific concepts actively. Dynamic pedagogical strategies can further enhance student interaction with scientific inquiries, making learning more impactful and reflective of real-life contexts. The curriculum incorporates digital resources and structured inquiry processes, thus enhancing engagement and understanding (Kotsis *et al.*, 2023b). These reforms acknowledge the pressing need for educational practices that foster autonomous learning, as reflected in a systematic review outlining the importance of structured inquiry phases in promoting student agency and responsibility.

Ultimately, this curriculum aims to develop scientifically literate individuals and aspires to prepare students for the challenges of a rapidly evolving world. Central to the modern educational paradigm, IBL is a student-centered instructional approach where learners actively

engage in the inquiry process to construct knowledge through exploration and problem-solving. This pedagogical strategy emphasizes critical thinking and fosters a deep understanding of scientific concepts by promoting hands-on experiences and real-world applications. This is particularly significant considering the goals outlined in the New Greek Primary Science Curriculum. Research indicates that IBL enhances students' motivation for learning, strengthens their ability to think scientifically, and sharpens their problem-solving skills, which is essential in cultivating informed citizens who can navigate an increasingly complex world (Kotsis *et al.*, 2023a). Inquiry-based learning allows for differentiated learning experiences tailored to students' diverse backgrounds and needs, enabling educators to address varied learning styles effectively and inclusively (Tompras *et al.*, 2023). As highlighted by (Leitão *et al.*, 2018), incorporating IBL not only aids in efficiently teaching significant scientific content but also encourages the development of collaborative and communicative skills that are vital for students in the 21st century. These skills are essential for teamwork, effective communication, and adaptability in professional settings. This supportive environment helps students cultivate a love for learning while preparing them for future challenges. Additionally, IBL empowers students to take ownership of their educational journey, fostering a sense of autonomy and personal investment in their learning process, which is increasingly essential in today's rapidly changing society. This holistic approach to learning underscores the importance of adapting the curriculum to include inquiry-based methodologies, enriching the educational landscape for future generations, and transforming education into a memorable and impactful process beyond the classroom.

This research aims to systematically investigate the integration of IBL into the Greek primary science curriculum, particularly emphasizing its implementation and effectiveness in fostering young learners' critical thinking and problem-solving skills. Recognizing the importance of collecting data and critically analyzing how IBL can transform instructional practices to improve educational outcomes is crucial. The study addresses significant gaps identified in the existing curriculum, as highlighted by the findings of (Stylos *et al.*, 2023a), which reveal pre-service teachers' misunderstandings about scientific inquiry that hinder their teaching efficacy. By rigorously analyzing successful practices from various European contexts, especially those aligned with national educational standards, the research proposes a coherent framework that enhances the learning environment by incorporating hands-on, inquiry-driven methods. The scope extends to critically evaluating curricular reforms discussed in recent symposiums, underscoring the necessity of developing a curriculum beyond mere theoretical content to engage students actively. This approach is vital for fostering a robust culture of inquiry, essential for nurturing scientifically literate citizens capable of navigating the complexities of the modern world (Mamas, 2013).

2. THEORETICAL FRAMEWORK OF INQUIRY-BASED LEARNING

The underpinnings of IBL are fundamentally rooted in constructivist theory, which posits that knowledge is constructed through active engagement rather than passive absorption of information. This paradigm emphasizes the importance of hands-on experiences where students actively question, explore, and reflect on their learning processes (Peterson, 2016). Such engagement strengthens their understanding and allows them to take ownership of their educational journeys. As evidenced in previous research, Kotsis *et al.* (2023c) emphasize that learners develop critical thinking skills essential for navigating complex scientific concepts effectively through active participation in inquiry. These skills enable students to analyze information, synthesize ideas, and apply knowledge in real-world contexts. Additionally, according to (Ruiz-Mallén *et al.*, 2020), integrating arts and digital technologies further enhances the interdisciplinary nature of IBL, fostering creativity and deep engagement among students. This integration allows learners to connect ideas across different fields while utilizing various forms of expression. However, challenges remain, as noted by (Mamas, 2013), where the prevailing medical model in discussions about inclusivity in scientific inquiry can restrict broader participation and limit the richness of collaborative learning experiences. Therefore, addressing these challenges is crucial for refining IBL frameworks in the new Greek primary science curriculum. It is essential to ensure that IBL encompasses diverse pedagogical strategies, incorporates varied teaching methods, and meets the educational needs of all students, thereby fostering an inclusive environment that promotes curiosity and critical engagement across the learner spectrum. This holistic approach can lead to a more enriched educational experience for every student involved in the inquiry process.

The evolution of IBL reflects a significant shift in pedagogical practices that aim to foster deep understanding and critical thinking among students. Historically, education relied heavily on rote memorization, a method that often neglected the development of critical skill sets necessary for real-world problem-solving. However, as educational theories progressed through the 20th century, the need for active engagement in learning became increasingly evident. The constructivist principles articulated by influential scholars such as John Dewey and Jean Piaget laid the groundwork for IBL, strongly advocating that learning is most effective when students are passive recipients of information and active participants in their educational journey. Research highlights the effectiveness of IBL within science curricula, demonstrating that hands-on experimentation significantly enhances students' cognitive processes, fosters excellent material retention, and increases their overall engagement with complex scientific concepts (Kotsis, 2024b). For instance, studies focusing on integrating inquiry methodologies in primary education reveal a notably positive impact on students' attitudes toward science and their ability to apply theoretical knowledge to real-world contexts, thus bridging the gap between theory and practice (Faria *et al.*, 2015). Moreover, effectively implementing such innovative teaching

methodologies is crucial for preparing educators to facilitate inquiry-based learning effectively. This necessity is underscored by the findings from recent curriculum developments in Greece, which merge historical insights from past educational practices with contemporary methodologies to enhance learning outcomes.

As the new Greek primary science curriculum increasingly incorporates IBL, it aligns seamlessly with these global trends that prioritize essential skills such as critical thinking, collaboration, and adaptability, preparing students for the complexities of the modern world. Furthermore, insights from (Ruiz-Mallén *et al.*, 2020) indicate that interdisciplinary methods, including the integration of arts and digital technologies, can significantly reinforce the objectives of IBL by enhancing student engagement and fostering critical inquiry. Additionally, understanding the dynamics of inclusion in educational settings, as outlined in (Mamas, 2013), emphasizes the importance of creating an environment where diverse learners can thrive, thereby enriching the inquiry-based experiences for all students.

3. KEY PRINCIPLES AND CHARACTERISTICS OF INQUIRY-BASED LEARNING

Central to effective inquiry-based learning is the emphasis on active student engagement, which fosters critical thinking and sharpens problem-solving skills through hands-on experimentation and exploration. This dynamic pedagogical approach encourages learners to frame their questions, design relevant experiments, and interpret their findings, thus transforming information into meaningful knowledge (Tompras *et al.*, 2023). At its core, inquiry-based learning promotes collaboration among students, as they often work in teams to tackle real-world problems. This collaboration significantly enriches the learning experience, benefiting from shared perspectives and diverse ideas (Kotsis, 2024b). Rather than viewing the learning process as a solitary endeavor, students are encouraged to communicate openly, share insights, and provide feedback to each other. Educational environments incorporating inquiry-based methods shift the focus from rote memorization to a deeply nuanced understanding of scientific concepts, effectively aligning with contemporary educational practices prioritizing deeper learning over superficial content absorption (Kalkanis, 2021). The integration of digital tools and resources in inquiry processes can significantly enhance students' abilities to collect and analyze data, making scientific inquiry not only more accessible but also more engaging for learners. These tools can facilitate virtual labs, simulations, and interactive experiments, opening new avenues for exploration and understanding in the scientific realm. These characteristics of inquiry-based learning foster a genuine, intrinsic interest in science and related disciplines, equipping students with the competencies necessary for informed citizenship and preparing them for future STEM careers (Jimenez-Aleixandre *et al.*, 2010). This aligns well with the objectives established in the new Greek primary science curriculum, emphasizing the importance of nurturing inquisitive minds that can thrive in the complexities of modern scientific challenges.

4. THE ROLE OF CONSTRUCTIVISM IN INQUIRY-BASED LEARNING

Incorporating constructivist principles into (IBL) fundamentally transforms the educational landscape, particularly within the context of the new Greek primary science curriculum. By emphasizing active participation, learners are encouraged to construct knowledge through hands-on experiences and critical reflection, fostering a deeper comprehension of crucial scientific concepts for their educational journey. This approach allows students to engage with the material personally and promotes the development of essential academic skills that will serve them throughout their lives. This aligns with the findings of Kotsis, who posits that engaging in experiments enables students to formulate questions, develop hypotheses, and evaluate results, thereby cultivating essential critical thinking and problem-solving skills vital in today's rapidly changing world (Kotsis, 2024a).

Integrating inquiry as an investigative process resonates with the perspectives of educators who have undergone transformative experiences in curriculum implementation, as noted in Stringer's action research model (Marshall, 2018). In a related study, incorporating culture within teacher education was shown to influence preservice teachers' development of critical consciousness and culturally responsive teaching practices, effectively equipping them to address the needs of diverse learners in their classrooms. This highlights how IBL, rooted in constructivist theories, supports academic achievement and encourages the adoption of sociocultural perspectives in learning environments (Jacobs *et al.*, 2015). Additionally, integrating practical learning experiences, such as creating a school garden, further exemplifies how inquiry-based methods can engage students from diverse backgrounds and foster a culture of sustainability. As emphasized by Stringer, reflective practice and adaptive learning environments are necessary for fostering an atmosphere where students feel empowered to explore and inquire. Adopting a constructivist framework within the curriculum aligns with contemporary educational goals and actively prepares students to navigate the complexities of real-world scientific challenges. This preparation ensures they become capable, informed citizens dedicated to lifelong learning and equipped with the skills to adapt and thrive in an ever-evolving society (Kotsis *et al.*, 2023c). Such an educational approach enriches the academic experience. It is pivotal in shaping responsible future leaders, as evidenced by the success of integrated instructional strategies that enhance student collaboration and critical thinking (Marshall, 2018).

5. CURRENT STATE OF SCIENCE EDUCATION IN GREECE

The landscape of science education in Greece is undergoing significant transformation, driven by the introduction of innovative curricula that emphasize inquiry-based learning and practical experimentation. Recent academic initiatives, such as the new Primary Education Science Curriculum, strive to cultivate critical thinking and collaboration among students, addressing previously identified gaps in scientific literacy and pedagogical practices

(Tsiouri *et al.*, 2024). By fostering a mindset oriented toward inquiry and exploration, Greece's educational reforms aim to enhance students' knowledge of scientific concepts and encourage them to engage actively with the material, fostering a deeper understanding of the natural world. The emphasis on experiential, hands-on learning reflects a broader European trend, wherein countries like Finland and Sweden prioritize inquiry and active engagement over rote memorization (Green *et al.*, 2010). These nations serve as models for Greece to emulate as it seeks to revamp its science education system. Nonetheless, the implementation challenges remain palpable; educators often grapple with resource constraints and the need for professional development to adapt to these evolving methodologies. Training programs ensure that teachers have the skills and knowledge to apply and teach the curriculum effectively. Systemic issues like cultural biases toward traditional teaching methods necessitate concerted efforts to harmonize current practices with the curriculum's objectives (Khan, 2011; Kotsis *et al.*, 2023b). Resistance to change can hinder progress, and overcoming these barriers is imperative for successfully adopting innovative practices. As educators navigate these complexities, integrating practical assessment tools aligned with inquiry frameworks is crucial for fostering a scientifically literate populace. Ultimately, this transformation aims to position Greece to embrace its critical role in global education, empowering future generations to face the scientific challenges of tomorrow with confidence and competence (Tsoumaki, 2019). The exploration of inquiry-based learning within the existing primary science curriculum reveals significant inadequacies hindering students' critical scientific literacy development. An in-depth curriculum analysis indicates that many pre-service teachers possess naïve views regarding scientific inquiry, which impedes their pedagogical effectiveness and ability to inspire student curiosity and engagement in the subject matter (Stylos *et al.*, 2023b). This lack of understanding is emblematic of broader systemic issues, as many educators are not adequately equipped with the theoretical knowledge and practical skills necessary to facilitate the required experiential learning that inquiry-based methods demand. Additionally, the minimal inclusion of practical activities throughout the curriculum constrains student engagement and hampers skill development in critical thinking and problem-solving. These essential competencies enable students to navigate and comprehend today's increasingly complex world (Kotsis, 2024b).

Despite positive outcomes observed in pilot programs emphasizing hands-on experimentation, a noticeable disconnect exists between curriculum objectives and actual teaching practices, resulting in a missed opportunity for transformative education that could cultivate a deeper understanding of scientific principles and processes (Kotsis *et al.*, 2023a). Recent research highlights that the Inquiry-Based Learning Model substantially positively impacts academic achievements in science education, particularly regarding active student engagement through exploration and investigation (Ramadansur *et al.*, 2023). Addressing these discrepancies is crucial for reforming the primary

science curriculum to align with contemporary educational needs. Moreover, it is essential to ensure that future scientists emerge from a system that fosters inquiry, collaboration, creativity, and resilience, moving away from rote memorization and passive learning experiences toward more dynamic modes of thinking. Ultimately, more robust investment in teacher training and curricular redesign is necessary to cultivate an environment that prioritizes inquiry-based approaches, empowering students to think critically, ask insightful questions, and engage deeply with scientific concepts early on. Such enhancements would enrich the learning experience and prepare students to become informed and innovative thinkers in a rapidly evolving world.

Implementing inquiry-based learning within the new Greek primary science curriculum presents several challenges that educators must navigate can significantly affect the educational process in various ways. One significant barrier is the transition from traditional, teacher-centered methodologies to a more student-focused approach, which requires educators to relinquish control over the entire learning process and fully embrace a facilitator role designed to empower students in their learning journey. This shift necessitates comprehensive professional development to enhance teachers' understanding of IBL principles and effective strategies for engaging students in exploration, inquiry, and critical thinking (Blatt-Gross, 2019). Educators need ongoing support and training to successfully adapt their teaching styles to meet the demands of this pedagogical shift, which often involves a considerable learning curve. Practical constraints, such as limited resources, inadequate classroom space, and a lack of administrative support, hinder the execution of hands-on experiments integral to IBL, as highlighted in (Kotsis, 2024a). These obstacles can discourage teachers from effectively implementing inquiry methods, decreasing enthusiasm in educators and students alike. Additionally, teachers face challenges in assessing student understanding in open-ended inquiry projects, as traditional assessment methods may not adequately capture the depth of learning fostered by IBL methodologies. The complexities of evaluating student progress in a system that emphasizes exploration, and critical thinking can be daunting, especially when educators feel pressured to demonstrate measurable outcomes through standardized tests. Consequently, addressing these multifaceted challenges is crucial for successfully integrating inquiry-based learning into the curriculum, ensuring that future educators can foster a scientifically literate and inquisitive student body capable of navigating an increasingly complex world. The need for a shift in mindset from teachers and administrators is vital, as embracing a culture of inquiry benefits students and creates a vibrant learning environment that inspires creativity and curiosity. With the proper support and resources, educators can overcome these challenges, ultimately transforming the educational landscape to better prepare students for the challenges of tomorrow.

Recent advancements in science education necessitate thoroughly examining how the new Greek primary science curriculum aligns with international standards.

A noteworthy aspect of this curriculum is its emphasis on inquiry-based learning, which resonates with the methodologies established in other educational frameworks, such as Finland and Sweden, where inquiry-based approaches dominate and elevate student engagement and understanding. It is essential to critically assess whether the Greek curriculum's implementation of inquiry-based methods fosters an environment conducive to deep learning or fulfills surface-level compliance with international benchmarks. Considering these benchmarks, integrating real-world applications in the Greek curriculum reflects a similar commitment to practical learning, akin to practices embraced in countries like Germany, where experiential learning is crucial for student development and mastery of concepts (Blythe, 2023). However, it is essential to evaluate how effectively these real-world applications are integrated and whether they genuinely resonate with students' experiences or are merely included to enhance curriculum legitimacy.

The new curriculum imparts knowledge and engages students in active learning, promoting a deeper understanding of scientific principles as they connect classroom theories to everyday experiences. The curriculums foster critical thinking, collaboration, and problem-solving, consistent with the global shift toward developing scientifically literate citizens equipped to address contemporary challenges locally and globally (Butler & MacGregor, 2003). This critical perspective encourages us to analyze how these skills are explicitly taught and assessed within the curriculum. As evidenced in successful models abroad, such as the J. Paul Getty Museum arts integration initiatives, the interdisciplinary approach endorsed in Greece promises enhanced student outcomes through integrating literacy, science, and the arts, thereby preparing students for a multifaceted world (Riggins, 2014). This commitment to a holistic educational experience not only enriches student learning but also promotes the development of a more versatile skill set, raising the question of how well these varied disciplines are genuinely integrated and whether they enrich students' academic and personal lives holistically. This comparative framework establishes a pathway for continuous improvement and adaptation, ensuring that Greek education meets national standards and aligns with leading international practices, ultimately fostering a generation of innovative thinkers and global citizens ready to tackle future challenges successfully.

6. STRATEGIES FOR INTEGRATING INQUIRY-BASED LEARNING

Inquiry-based learning (IBL) integration within the new Greek primary science curriculum necessitates a multifaceted approach emphasizing hands-on experiments and real-world applications, compelling students to think critically about the information they encounter. To ensure a comprehensive learning experience, strategies should include the design of lessons that encourage students to formulate thoughtful questions and challenge them to assess the validity of their hypotheses based on prior knowledge and evidence. This active engagement in exploratory investigations aligns with Kotsis's insights

on fostering critical thinking through participation in scientific inquiry (Kotsis *et al.*, 2023b). Aligning the curriculum with contemporary scientific themes, such as climate change and health, enhances relevance and fosters critical analysis, promoting a deeper understanding of pressing global issues. Recent curriculum updates emphasize creating responsible, informed citizens who can engage thoughtfully with their communities and environments (Kotsis, 2024b). Integrating digital resources can further enrich the learning experience by providing access to innovative tools for data analysis, collaborative research, and interactive simulations, making complex scientific concepts more accessible and allowing students to explore various perspectives on scientific issues (Lee & Spratley, 2010; Marshall, 2018). Professional development opportunities for educators to enhance inquiry-based pedagogy skills are critical for successfully implementing these strategies. Educators can effectively overcome challenges typically presented by traditional, rote memorization curricula by adopting these approaches and incorporating diverse methodologies from global perspectives, as noted in the recent collection of scholarly articles that underscore innovative practices in science education (Çavas *et al.*, 2023). These articles highlight the significance of personalized professional development and competency management in promoting IBL effectively. Thus, this creates an environment conducive to critical analysis and discussion, in which students acquire foundational knowledge and develop essential critical thinking and problem-solving skills for lifelong learning and scientific inquiry (Egetenmeyer, 2015). This proactive engagement with IBL equips students not just for academic achievement but also for informed citizenship in an ever-evolving world where critical assessment of information becomes paramount.

Teachers must get effective professional development for the Greek primary science curriculum to successfully incorporate inquiry-based learning. To equip educators with the necessary skills, targeted training emphasizing experiential learning and collaborative inquiry methods is essential, allowing teachers to understand and apply these concepts in their classrooms deeply. Research demonstrates that teachers often face significant challenges in integrating inquiry-based approaches due to insufficient self-efficacy in science teaching (Stylos *et al.*, 2023b). Consequently, professional development programs must enhance content knowledge and incorporate pedagogical strategies that bolster teachers' confidence and enrich their instructional practices. A study observing the impact of the Primary Connections initiative found that teachers who engaged with structured professional development exhibited improved self-efficacy and committed more time to science education, ultimately benefiting their student's learning experiences (Albion & Spence, 2013). Continuous support and a robust community of practice are critical for sustaining transformation efforts, ensuring educators can effectively navigate complexities and improve student engagement through innovative teaching practices (McGee, 2001). This collaborative environment encourages sharing best practices, resources, and experiences, which can further enhance professional growth. Thus,

ongoing professional development should be viewed as an iterative process that evolves, preparing teachers to deliver high-quality science education effectively. By fostering a culture of continuous learning and adaptation, we can better prepare teachers to meet the challenges of today's educational landscape while empowering student inquiry and exploration in the sciences. Ultimately, this investment in professional development is essential for the long-term success and sustainability of inquiry-based learning within the curriculum.

Developing a curriculum that is both effective and comprehensive requires careful planning when allocating resources. This is because theoretical frameworks and real-world applications must be seamlessly blended. The new Greek Primary Science Curriculum strongly emphasizes inquiry-based learning and requires various resources supporting hands-on experiments and facilitating student collaborative activities. It is vital to critically analyze how these pedagogical components have been shown to positively influence critical thinking skills and encourage students to interrogate and synthesize information, thereby promoting a deeper understanding of essential scientific concepts. Aligning curriculum objectives with the currently available resources, including various digital tools and well-maintained laboratory equipment, is crucial in facilitating innovative teaching practices that resonate with contemporary educational standards. Educators must consider how these resources can be utilized effectively across different teaching scenarios to maximize their impact. In addition, studies have consistently emphasized the significance of well-structured inquiry processes and engaging materials, highlighting their role in promoting active learning environments that captivate students' interests and elevate their academic performance (Kotsis, 2024b; Ruiz-Mallén *et al.*, 2020). Consequently, the successful implementation of this curriculum hinges on the intentional and thoughtful allocation of resources that not only address pedagogical needs but also effectively adapt to the diverse learning styles of all students, ensuring inclusivity for every learner (Kotsis *et al.*, 2023a; McGee, 2001). Moreover, an ongoing evaluation of resource efficacy must be integrated within the curriculum framework to sustain continuous improvement and adapt to evolving educational demands, thus ensuring long-term success and relevance (Aceska, 2015). Through this approach, educators can optimally support student learning and engagement in a dynamic learning environment, reflecting on their strategies and adjusting as necessary based on student feedback and academic outcomes.

A key component of assessing inquiry-based learning outcomes is efficient assessment techniques. The rote memory component of traditional assessment methods frequently precedes critical thinking, making it difficult to gauge how well students grasp a subject in an inquiry-based environment. Instead of relying solely on conventional methods that may overlook significant aspects of student learning, educators must implement formative assessments, such as peer feedback and self-reflection, which actively engage students in their learning. These methods allow students to take ownership of their educational journey, as supported by research

highlighting the importance of student involvement (Stylos *et al.*, 2022). Such assessments facilitate real-time adjustments to teaching strategies based on students' diverse needs and responses, encouraging a more responsive educational environment. Additionally, incorporating various evaluation tools, including performance assessments that emphasize process-oriented outcomes rather than merely assessing content knowledge, significantly enhances the comprehensiveness of assessment frameworks (Tompras *et al.*, 2023). These tools encourage students to demonstrate their understanding through hands-on activities and projects and foster a critical-thinking mindset that aligns closely with the principles of inquiry-based learning. Employing modern technology, as suggested by (Ruiz-Mallén *et al.*, 2020), further aids in collecting and analyzing data more effectively, ensuring that assessments are accurate and aligned with the inquiry principles that underpin effective science teaching. Integrating inquiry-based learning with disciplinary literacy can foster practical assessment and enhanced student engagement. Ultimately, these innovative assessment methods nurture critical thinking and creativity, equipping students with essential skills for real-world applications of scientific inquiry. By reinforcing the curriculum's overarching educational goals, these approaches help students learn about science and prepare them to become capable, thoughtful contributors to the scientific community, enhancing their educational experience, which is increasingly supported by frameworks promoting interdisciplinary approaches to teaching.

7. DISCUSSION

Integrating IBL into the new Greek primary science curriculum presents numerous implications for future research and practice. A robust understanding of scientific inquiry among pre-service teachers is essential, as evidenced by the findings that indicate prevalent misconceptions regarding scientific methodologies (Stylos *et al.*, 2023a). Future studies should focus on developing comprehensive professional development programs that equip educators with the tools to effectively facilitate inquiry-based approaches, addressing the identified gaps in their scientific literacy and self-efficacy beliefs (Stylos *et al.*, 2023b). The importance of interdisciplinary learning, championed in recent curricular frameworks, is underlined by the need for collaboration among educators across subjects (Albion & Spence, 2013; Lee & Spratley, 2010). By embracing a systematic and structured inquiry cycle, as proposed by Pedaste *et al.* (2015), educational practices can be refined to enhance student engagement and critical thinking skills. The transition to integrated approaches in education also highlights that utilizing an inquiry-based model fosters a more efficient alignment with various content areas, ultimately benefiting student outcomes. Ultimately, continuous evaluation and adaptation of these pedagogical strategies are fundamental to fostering a generation of students capable of navigating complex scientific challenges.

The transition towards an inquiry-based learning framework within the new Greek primary science curriculum

represents a significant step forward in fostering critical thinking and scientific literacy among young learners. By emphasizing hands-on experimentation and collaborative inquiry, the curriculum aligns with contemporary educational goals that seek to engage students actively in the learning process. This methodology cultivates a deeper understanding of scientific principles and equips students with essential skills in an evolving technological landscape. However, it is crucial to consider the reported moderate levels of self-efficacy among teachers in science instruction as outlined in the study (Albion & Spence, 2013). In addition, the necessity for significant time allocation for science education raises questions about resource distribution and educational priorities within schools (Marshall, 2018). This highlights the importance of ongoing professional development accompanying curriculum changes, as it ensures that educators feel supported and confident in their teaching practices, which is fundamental for the successful implementation of any educational reform. While the successful application of inquiry-based approaches across different educational contexts, as demonstrated in cross-national studies, provides valuable insights, it also underscores the need for a tailored implementation strategy that respects local cultural frameworks while promoting scientific inquiry (Spyrtou *et al.*, 2018).

8. CONCLUSION

In conclusion, integrating inquiry-based learning into the curriculum enhances educational outcomes. It lays the groundwork for informed citizens to engage with complex scientific issues daily. This is important in today's world, where the capacity to think critically about science is integral to participating in society, thus fulfilling the overarching objectives of educational reform. The research findings illuminate several critical dimensions regarding integrating inquiry-based learning in the new Greek primary science curriculum. First, the emphasis on experiential learning through hands-on experiments serves not only to enhance students' comprehension of scientific concepts but also plays a vital role in cultivating critical thinking and problem-solving skills that are essential for their future roles as informed citizens. While significant strides in understanding the nature of scientific inquiry were noted among pre-service teachers, it is essential to critically acknowledge that challenges remain, particularly concerning persistent misconceptions about scientific methodologies. Notably, the curriculum's design incorporates contemporary scientific themes, such as climate change and health, which align with modern educational goals and resonate with student interests, suggesting a strategic relevance. Adjustments in assessment strategies to prioritize critical thinking over traditional testing methods have emerged as a crucial recommendation, indicating a necessary shift toward fostering deeper engagement with scientific content. This multifaceted approach aims to cultivate a generation of knowledgeable and equipped learners to participate actively in scientific discourse and inquiry, thereby enriching the overall educational experience.

To effectively implement IBL within the new Greek primary science curriculum, policymakers prioritize the alignment of curriculum frameworks with pedagogical practices that promote active learning and critically evaluate those practices' efficacy in diverse classroom settings. This alignment necessitates ongoing professional development for teachers, ensuring they are equipped with evidence-based strategies and the confidence to facilitate inquiry-based methodologies successfully. Moreover, developing assessment tools should transcend traditional testing methods; it must embrace formative assessments that critically evaluate students thinking processes and problem-solving skills, fostering a deeper understanding of scientific concepts. Collaboration among educational stakeholders—such as teachers, researchers, and curriculum developers—must be emphasized, as this will facilitate the sharing of best practices and resources that underpin effective IBL implementation. Additionally, integrating technology and community resources into science education must be approached with discernment to ensure they enrich and enhance real-world connections, thereby multiplying students' learning experiences. A comprehensive approach to policy and curriculum development should create a dynamic educational environment that nurtures inquiry-driven mindsets and equips students to engage thoughtfully and critically with the complexities of scientific inquiry and applications.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

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