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Comparing Science Curriculum for Primary Education in Greece and Serbia

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Abstract

This research systematically compares the science curricula of primary education in Greece and Serbia, aiming to identify key similarities and differences that impact educational outcomes in each context. The study provides a nuanced understanding of these educational landscapes by examining the frameworks for teaching science and revealing how national policies, pedagogical approaches, and cultural contexts influence curriculum development in

both nations. The study looks at a number of topics, including curriculum content, instructional strategies, evaluation methods, and general educational goals that are common in every country's educational system. The study emphasizes the historical pedagogy that has shaped these educational systems and each nation's particular difficulties over the years, including sociopolitical elements that have impacted educational reforms, such as wars and regime changes. Additionally, the study supports PISA results, which highlight the value of encouraging students to apply their knowledge to real-world situations and cultivating the critical thinking and social awareness necessary for active citizenship. The study also considers historical events when designing curricula, showing how educational frameworks are connected to particular historical contexts and how these influences impact pedagogical approaches and content. Finally, by highlighting the advantages and disadvantages of each system and promoting the discussion of curriculum innovation in a quickly changing global education environment, this comparative analysis provides insightful information for possible educational reforms that could help both nations.

Keywords: science curriculum, primary education, pedagogical approaches, Greece, Serbia

1. Introduction

The fundamental educational frameworks significantly impact young students' cognitive and social competencies, affecting their long-term academic paths and general development. Examining how these two teaching philosophies successfully meet the various developmental needs of primary school pupils becomes crucial when comparing the science curricula of Greece and Serbia. These countries have several common characteristics deeply rooted in their historical, cultural, and political landscapes. Both countries have constitutions that reflect significant Orthodox Christian values. Greece's constitution shows a more pronounced connection due to its uninterrupted constitutional tradition, unlike Serbia, which experienced disruptions during communist rule. Historically, both nations have been influenced by the Byzantine Orthodox Church, which played a crucial role in their cultural and religious development during the Middle Ages. In the modern era, Greece and Serbia have experienced post-authoritarian transitions, with both countries grappling with the legacies of past regimes that have impacted their democratization processes. These transitions have been marked by the retention of power by old regime structures, leading to challenges in establishing fully functional democracies. Additionally, during the Balkan conflicts of the 1990s, Greece notably supported Serbia, diverging from its Western allies, highlighting a complex political relationship influenced by historical allegiances and shared Orthodox Christian ties. These shared characteristics underscore Greece and Serbia's intertwined historical and cultural narratives, shaping their contemporary identities and political landscapes.

Despite their close proximity and historical ties through shared influences and cultural exchanges, both nations have different educational philosophies and curricula that call for careful comparison. This study will adopt a thorough methodology, exploring a number of topics, including the curriculum, instructional strategies, evaluation methods, and the general educational goals that are present in each country's educational system. Through the use of both qualitative and quantitative data, the study seeks to pinpoint important parallels and divergences between the instructional strategies used, with an emphasis on how these approaches encourage scientific inquiry, as in Europe (Tsiouri et al., 2024a) and improve conceptual understanding among primary students in each setting. It is also critical to understand that these variations and parallels reflect deeper cultural values and educational priorities unique to each country. In the end, a more thorough examination of these curricula reveals the advantages and disadvantages of each system and provides insightful information about possible educational reforms that might be advantageous to both nations. These revelations could greatly improve the efficacy of science instruction in both settings and open the door to a more comprehensive and globally conscious method of teaching science in elementary schools. We can promote a more thorough discussion about best practices in science education by highlighting the significance of such comparative studies, which may result in better learning outcomes for students worldwide.

Science curricula in elementary school are crucial because they help students develop scientific literacy and critical thinking skills, which are necessary for navigating a world that is becoming more and more influenced by science and technology. A scientifically literate

populace is the result of effective primary science education, which also affects students' long-term interest in science (Deehan et al., 2022). (Vieira & Tenreiro-Vieira, 2016). Research suggests that student-centered interventions in primary science education effectively improve science learning outcomes by significantly improving content knowledge, skills, and attitudes (Deehan et al., 2022). Although they necessitate significant teacher commitment and professional development, integrated curricula—which integrate science with other subjects—have been demonstrated to increase the amount of time spent on science in schools and spark enthusiasm among both students and teachers (Gresnigt et al., 2014). As evidenced by initiatives to combine social constructivist methods with Vietnamese cultural values in an effort to foster the development of comprehensive scientific knowledge and skills, science curriculum design must also take cultural contexts into account (Hằng et al., 2017). Additionally, a revised Bloom's taxonomy analysis of primary science curricula in Singapore and Korea emphasizes the intellectual demands made on students and the necessity of curriculum alignment to guarantee access to abstract disciplinary knowledge (Lee et al., 2015). When taken as a whole, these studies highlight the many advantages and difficulties of putting in place a successful science curriculum in elementary school, highlighting the necessity of creative teaching strategies and cultural awareness to improve learning outcomes and student engagement.

The incorporation of a thorough science curriculum in early education has a major impact on the foundation of a strong educational system. Young students who participate in scientific research develop critical thinking, creativity, and problem-solving abilities—qualities that are essential in the quickly changing world of today. Additionally, exposing children to scientific ideas at a young age can spark their curiosity and lifelong love of learning, preparing them to handle difficult societal issues. The PISA emphasizes the significance of providing students with relevant knowledge and skills necessary for contemporary engagement in society, according to research on innovative educational assessments (PISA, 2012). Integrating media and information literacy into the science curriculum is crucial as nations work to improve educational outcomes because it not only helps create informed citizens but also enhances the learning process by relating academic material to practical applications (McDougall et al., 2017). As a result, in both Greece and Serbia, the science curriculum is a vital component in producing knowledgeable, competent people.

Due to historical, cultural, and legal factors, primary education in Greece and Serbia has both distinctive features and common difficulties. With roots in ancient Greek and Byzantine education, Greece's educational system is steeped in historical traditions that continue to influence modern curricula and pedagogical approaches (Anastasopoulou et al., 2024). Notwithstanding this rich history, the Greek primary education system still faces many obstacles, such as the need for improved teacher preparation, decentralization, and parental involvement. In Greece, primary school teachers are prepared through a structured curriculum that spans several pedagogical departments and aims to give teachers the tools they need to handle these difficulties (Korotkova, 2022). Eight years of primary education, broken up into two educational cycles, are required in Serbia. Although there are legal

frameworks in place to ensure compliance, the Serbian system requires parents to enroll their children in primary school, despite the lack of effective enforcement mechanisms (Vlaskovic, 2023). As long as the child is initially enrolled in a primary school, the Serbian educational system also permits home or distance learning (Vlaskovic, 2023). According to comparative studies with Czechia, Serbian primary education is modernizing to meet international standards, but there are still obstacles in the way of achieving these objectives (Lukić et al., 2022). Reflecting larger trends in educational reform and development, both nations are working to improve their primary education systems in order to better serve the needs of contemporary students.

Greece's and Serbia's primary education histories demonstrate the strong sociopolitical forces that have influenced their respective educational systems over time. One of Greece's defining features has been the way that education and national identity are intertwined, and reforms there frequently mirror larger societal goals for modernization and EU membership. Numerous advancements in curriculum design and pedagogical approaches have been made possible by this historical background. This is especially true of recent educational policies that seek to increase student interest in STEM (Science, Technology, Engineering, and Mathematics) fields, which are thought to be essential for future innovation and economic stability. However, Serbia has faced many obstacles in its primary education journey, such as persistent economic instability and outside pressure from international organizations pursuing educational reform. These difficulties have resulted in curricula that frequently fall short of meeting the needs of students and modern educational standards, which has led to a gap in educational access and achievement. Greece and Serbia have acknowledged the growing need to modify their educational approaches in order to better prepare students with the variety of skills necessary to engage in a quickly changing global society, even in spite of these obvious disparities in their educational systems. Critical thinking and problem-solving abilities are crucial in the classroom because educational stakeholders in both nations have recognized that students' ability to apply their knowledge in real-world situations is essential to their success (PISA, 2012). Analyzing their current science curricula and possible reform areas requires an understanding of these backgrounds, which aids stakeholders in identifying successful development and implementation strategies.

This study's main goal is to compare the science curricula of Serbian and Greek primary schools methodically in order to pinpoint important parallels and divergences that affect learning outcomes in each setting. This study aims to provide a nuanced understanding of these educational landscapes by examining the frameworks for teaching science in order to reveal how national policies, pedagogical approaches, and cultural contexts influence curriculum development in both countries. This kind of investigation is essential because it sheds light on the larger educational philosophies and practices that influence instruction in every country. The research's findings are meant to further the conversation about curriculum innovation, especially in light of the quickly changing global educational landscape. The results are expected to show notable differences in health and educational paradigms, similar to the distinctions between the UK and French health systems in terms of policy and practice,

in keeping with earlier studies on cross-border educational initiatives (West et al., 2018). Aspects of curriculum implementation that are crucial to assessing the effectiveness of the educational process, including teacher preparation, resource allocation, and assessment techniques, will also be examined in detail. Furthermore, the historical background of mathematics education highlights the significance of curriculum design, implying that a comparable analysis of science curricula can produce significant outcomes applicable to both countries (Lawrence & Djokić, 2014). Additionally, this study seeks to advance the field by offering practical suggestions that could improve pedagogical approaches in Serbia and Greece, encouraging cross-cultural cooperation and educational advancement. Both countries face challenges in their educational systems due to historical, cultural, and socio-political influences, which have resulted in curricula that often do not align with contemporary educational demands. This misalignment has led to gaps in educational access and achievement, as well as a need for reforms better to prepare students for a rapidly changing global society.

2. Historical Context of Science Education

The development of scientific ideas and societal shifts are intricately linked to the historical background of science education. From the Athenian period to the Renaissance and the Industrial Revolution, the evolution of the scientific method demonstrates the advancement of scientific fields and their influence on society (Saha, 2022). Modern science education, which increasingly integrates a historical approach to pedagogy, has been impacted by this historical trajectory. Teachers can assist students in comprehending the complex nature of scientific advancement and its socio-cultural aspects by placing scientific discoveries, like the invention of the Leiden jar, in a larger context (Jardim et al., 2021). Political and economic factors are also evident in the history of science education, especially the significant American influence on the positivist science paradigm that influenced teaching methods from the late 20th century into the 21st (Ribeiro et al., 2021). Additionally, as demonstrated by the responses to educational needs in the United States and Britain since the 1960s, which have influenced international educational policies, societal demands have historically spurred changes in science education (Kidman & Fensham, 2020). Educational paradigms that emphasize the connection between science, technology, and societal development are still influenced by the philosophical foundations of scientific rationality, which were established in the 17th and 18th centuries (Makarov & Bohatyrchuk, 2022). When taken as a whole, these historical observations highlight the dynamic interaction between scientific discoveries and teaching methods, emphasizing the value of placing science instruction in larger historical and cultural contexts.

Historical and cultural contexts have had a significant impact on the development of science education, profoundly influencing how different countries approach their curricula. It is crucial to take into account the historical pedagogy that has shaped these educational systems as well as the particular difficulties that each nation has encountered over time when analyzing the science curricula in primary school in Greece and Serbia. A comparative analysis reveals the socio-political factors—such as wars, regime changes, and sociocultural

shifts—that have influenced educational reforms in these regions in addition to the adaptations made in response to scientific advancements. For instance, during Turkey's Republican era, major modifications to geography curricula mirrored more general educational objectives meant to develop students' analytical abilities (Şahin, 2021). These modifications are part of a larger pattern whereby curricula frequently reflect the goals and values of a country at critical junctures in its history. Because it emphasizes the need for innovative curricula that are reflective of current scientific developments—especially in light of globalization and the rapid pace of technological advancement—this historical lens is essential for understanding current science education frameworks (Coburn et al., 2017). In the end, acknowledging these historical influences aids in a better understanding of the current state of education in both Greece and Serbia, enabling educators and decision-makers to draw on prior knowledge to develop more successful and pertinent science education plans for coming generations. Understanding this historical background helps one comprehend the reasons behind present practices and how they might develop further.

2.1 Evolution of Science Curriculum in Greece

Greece's science curriculum has developed through a complicated interaction of pedagogical approaches, educational policies, and outside evaluations. Greek students' below-average performance on PISA tests highlights the lack of a coherent strategy despite numerous efforts to improve science education. This calls for curriculum reform, creative teaching methods, and better teacher preparation (Karagiannidis, 2022). Despite the lack of strong religious opposition in this largely Orthodox Christian nation, teaching evolution—a crucial part of biological literacy—faces difficulties because pre-service and in-service teacher preparation is inadequate (Stasinakis & Kampourakis, 2018). The nature of science (NOS) elements of evolution and Mendelian genetics are presented in Greek secondary school biology textbooks, but they are frequently not explicitly incorporated into the larger curriculum, which is a global problem in science education (Kampourakis, 2017). Although the Greek science curriculum theoretically supports PISA's focus on problem-solving and critical thinking, in practice, especially in primary education, it frequently falls back on conventional, knowledge-based methods, as demonstrated by the "Explore the Natural World" curriculum (Pramas & Koumaras, 2017). Additionally, although these opportunities are not fully realized in current teaching practices, there are opportunities for cross-curricular integration of science in elementary education that could promote a more comprehensive approach to scientific literacy (Karampelas, 2019). Overall, systemic reform is required to bring educational practices into line with international standards and better prepare students for a world that is increasingly complex in terms of science and technology. This is evident in the evolution of the Greek science curriculum.

Greek science education has seen substantial changes over the years, reflecting both societal demands and more general educational reforms. These modifications have over time reflected both domestic and global patterns, suggesting a responsiveness to the changing global educational environment. Initiatives have placed a greater emphasis on incorporating creativity into the science curriculum in recent decades, in line with worldwide trends in

education. As evidenced by recent findings showing international agreement on the creative nature of science education, this progressive approach implies that science is not just a body of knowledge but an intrinsically creative endeavor (Hetherington et al., 2019). These viewpoints are essential since Greece wants to help students develop their critical thinking and problem-solving abilities. The educational system equips students to tackle complex problems that call for creative and analytical solutions by fostering these skills. Furthermore, as the European framework for environmental education (Hadjichambis et al., 2019) notes, the emphasis on environmental citizenship reflects a changing focus on educational priorities, where knowledge aligns with civic responsibilities. This emphasis emphasizes how crucial it is to provide students with knowledge of facts or theories and their implications for society and the environment. As a result, the development of the Greek science curriculum demonstrates an adaptive teaching approach that aims to give students the skills they need to actively participate in society in addition to scientific literacy. This development shows a dedication to raising a generation of knowledgeable citizens who can successfully navigate the difficulties of the contemporary world and make constructive contributions to their communities.

2.2 Development of Science Curriculum in Serbia

Numerous projects and difficulties have shaped Serbia's science curriculum, which reflects both regional educational demands and worldwide trends. The "Ruka u Testu" (Hands-on, La Main à la pâte) project is one noteworthy endeavor that was first implemented in Serbian primary schools in 2001 and has had official Ministry of Education support since 2003. In order to promote early scientific inquiry and comprehension, this program places a strong emphasis on experiential learning for young students (Jokic, 2007). However, there are difficulties in putting such programs into practice, especially when it comes to resource availability and teacher readiness. Due to a lack of professional and methodological knowledge, as well as a lack of literature and technical resources, many Serbian teachers, particularly those in Vojvodina, report difficulties teaching optional science subjects like "Hands in Dough" (Cvjetićanin et al., 2011). This suggests that more teacher preparation is required to improve their ability to use scientific methods successfully. Furthermore, Serbia's science curriculum is a component of a larger educational framework that is impacted by ideologies and developments in education around the world. This can occasionally lead to ideological discontinuities and inconsistent practices across various educational levels ("Science Education Curriculum", 2022) (Krnjaja, 2014). These difficulties show how complicated curriculum development is in Serbia, where attempts to update and enhance science instruction must consider pedagogical and ideological considerations to give students a coherent and successful educational experience.

Broader educational reforms intended to bring national standards into line with European standards—particularly in light of the Bologna Process—have had a substantial impact on the development of Serbia's science curriculum. As educators worked to increase the relevance and efficacy of their programs, these reforms required a critical reevaluation of the curriculum and teaching strategies to guarantee compliance with international standards.

Consistent with worldwide patterns seen in other areas, including the OECD nations, the Serbian curriculum places a strong emphasis on students developing critical thinking and problem-solving abilities by emphasizing both the application of scientific ideas in practical contexts and the acquisition of factual knowledge (PISA, 2012). This method seeks to prepare students for real-world problems they might encounter in their future employment in addition to academic exams. Furthermore, a growing understanding of the value of contextual learning—which helps students make connections between various fields of study—is reflected in the inclusion of interdisciplinary approaches in the science curriculum. This is especially noticeable in the evaluation methods that follow the guidelines set forth by the European Association for Public Administration Accreditation (Matei, 2009). The goal of developing a strong science education that is both comprehensive and flexible enough to meet the ever-evolving needs of contemporary society is unwavering as Serbia carries out these reforms. The curriculum seeks to give students the skills they need to handle challenging scientific ideas and societal issues in their future undertakings by creating a learning environment that values teamwork, inquiry, and critical thinking. This will ultimately help to create informed and involved citizens.

2.3 Influence of Historical Events on Curriculum Design

Global educational systems have been significantly impacted by historical events, leading to complex curriculum designs that capture the complex social, political, and cultural dynamics of each place. It is clear from analyzing the science curricula of Greece and Serbia that these nations' educational systems are closely tied to their distinct historical backgrounds, which have been shaped by a number of events like political upheavals, wars, and socioeconomic shifts. One notable example of a shift toward incorporating innovation and entrepreneurship into educational paradigms is the creation of the Entrepreneurship Research and Development Network in Eastern Europe. According to this initiative, curriculum evolution and reform can be influenced by historical movements and governmental policies (Szabó, 2011). A trajectory like this emphasizes how urgently adaptive teaching methods that intentionally address shifting social norms and expectations are needed. Additionally, the role of information literacy in influencing educational outcomes is highlighted by the comparison of school library functions in digital Europe, which highlights how curriculum design frequently reflects broader historical and technological changes in society (Boelens, 2010). In addition to helping to shape the curriculum taught in classrooms, this link between historical events and education also affects the pedagogical approaches and methods employed by teachers. In order to comprehend how educational practices in Greece, Serbia, and indeed the rest of the world continue to change in response to continuous shifts in their historical narratives and contexts, it is imperative that history and curriculum design continue to interact. Teachers and legislators can develop more effective curricula that meet the needs of modern students while respecting the lessons learned from the past by identifying and evaluating these influences.

3. Curriculum Framework and Standards

A robust curriculum framework plays a pivotal role in shaping educational outcomes, particularly in science education for primary schools, where foundational knowledge and skills are critical to student development (Tsiouri et al., 2024b). In examining the science curricula of Greece and Serbia, significant discrepancies in curriculum standards emerge, reflecting broader educational philosophies and practices that each country embraces. For instance, integrating human health and environmental awareness in Serbia's primary education curriculum underscores a growing recognition of interdisciplinary approaches necessary for fostering a holistic understanding of the world. However, studies reveal that students often lack the essential knowledge to contribute effectively to these areas, leaving them unprepared to tackle contemporary challenges (Stanišić & Maksić, 2014). This gap highlights the necessity for curriculum reform to better align educational practices with current pedagogical standards and societal needs. Conversely, Greece's science curriculum may benefit from a comparative analysis that identifies strengths and weaknesses, allowing for the development of a more cohesive framework that emphasizes practical applications of scientific concepts and inquiry-based learning. Such an evaluation not only enhances curricular compatibility but also ensures that educational frameworks are responsive to the evolving demands of society (Kotsis et al., 2023). By focusing on aligning educational standards with real-world applications, the curriculum can ultimately enrich students' learning experiences, foster critical thinking skills, increase student engagement, and enhance their preparedness for future academic and professional endeavors. Therefore, addressing these discrepancies and potential areas for improvement is essential for driving educational progress in both countries.

3.1 National Education Policies in Greece

The national education policies in Greece have evolved through various historical and socio-political contexts, reflecting a complex interplay of language, technology, and global influences. Historically, the Greek education system has been shaped by the tension between purist and colloquial Greek, which has impacted its competitiveness on an international scale (Papaoikonomou, 2022). During the early 20th century, the Liberal Party's educational policies aimed at national integration through cultural assimilation, emphasizing the teaching of the demotic Greek language to achieve national homogenization (Iliadou-Tachou et al., 2022). In recent years, Greece has focused on integrating smart education by enhancing technological infrastructure and promoting digital literacy among teachers and students, aligning with the national strategy for Digital Greece (Ferretti, 2023). The economic crisis of the 2010s further influenced educational policies, particularly in the realm of teacher and school evaluations, where legislative changes were driven by international economic agreements, leading to a blend of pedagogical and technocratic evaluation models (Kolympari et al., 2020). Additionally, the global agenda on education has introduced policies emphasizing competencies, school autonomy, and accountability, although these have struggled to become institutionalized in Greece. This reflects a broader trend of globalized educational discourses impacting local pedagogic practices, particularly in the context of the

Modern Greek Language curriculum (Tsatsaroni & Koutsiouri, 2022). Overall, Greek education policies are characterized by a dynamic interaction between historical language debates, technological advancements, economic constraints, and global educational trends.

The evolution of national education policies in Greece has significantly impacted the structure and delivery of science curricula at the primary education level, effectively transforming how educational content is approached in classrooms across the nation. Recent reforms have aimed not only to enhance educational quality and accessibility but also to adapt to the dynamic needs of a contemporary society. These initiatives reflect a broader European trend that favors student-centered learning, which emphasizes the importance of active engagement and participation in the learning process, as well as the integration of transversal skills—such as communication, teamwork, and critical thinking—into curricula. These evolving policies have been crafted to respond not only to domestic educational needs, rooted in the unique cultural and social contexts of Greece but also to international benchmarks that have gained prominence over recent years, such as those established by the PISA. This assessment program underscores the importance of critical thinking and problem-solving abilities in modern education, which have become essential for students to thrive in a globalized world (PISA, 2012). Furthermore, in light of ongoing financial constraints and socio-economic challenges, Greek education policy has had to navigate the delicate balance between maintaining educational standards and adapting to the realities of resource limitations in schools (Coburn et al., 2017). This intersection of national policy, curriculum development, and practical implementation ultimately shapes the educational landscape in Greece, influencing how science is taught and learned, and presenting both opportunities and challenges that differentiate Greek education from neighboring regions, such as Serbia.

3.2 National Education Policies in Serbia

National education policies in Serbia are shaped by a variety of factors, including the need for intercultural understanding, health system reform, vocational education and training (VET), and environmental education. Service learning projects in Serbian schools aim to reduce intolerance by encouraging students to view each other as individuals rather than marginalized groups, highlighting the potential for educational initiatives to foster multicultural understanding in post-conflict societies (Dull, 2009). In the realm of health education, Serbia has implemented National Health Accounts (NHA) to improve the efficiency and equity of health services, which indirectly influences educational policies by providing data for health-related educational programs (Gajić-Stevanović, 2015). The VET policy in Serbia, influenced by the EU accession process, focuses on employability and adapting education systems to labor market needs, though there is a noted tension between these goals and the need for social inclusion (Bartlett & Pagliarello, 2016). Environmental education is also a significant component of the Serbian primary school curriculum, though challenges remain in effectively implementing these programs to enhance students' knowledge and awareness of health and environmental issues (Stanisic & Maksic, 2014). Collectively, these policies reflect a multifaceted approach to education in Serbia, addressing

both immediate economic needs and broader social and environmental goals.

Serbia's national education policies have undergone significant transformation in recent years, with a pronounced focus on improving the quality and accessibility of education across the country to ensure that all students have the opportunity to succeed. The Ministry of Education has initiated various reforms aimed at aligning the Serbian education system with broader European standards, thereby enhancing both educational equity and efficiency, which are critical components for a modern educational framework. Central to these reforms is the adoption of competency-based curricula, which prioritize critical thinking and practical application of knowledge in scientific subjects, fostering a deeper understanding of the material among students. This shift is particularly pertinent when contrasting Serbia's approach to science education with that of Greece, as the former is now exploring innovative pedagogical methods emphasized in international assessments like PISA. Such developments reflect the growing recognition within Serbian policies that modern education must not only equip students with content knowledge but also with the skills necessary for real-life problem solving, thereby ensuring that learners are adaptable and capable of navigating complex challenges in various contexts. Furthermore, these reforms also seek to address regional disparities in educational quality, aiming to provide effective teaching resources and training for educators throughout the country. By fostering collaboration with international educational institutions, Serbia aims to create a more relevant and robust educational system that prepares a generation equipped for active participation in a globalized society and future workforce (PISA, 2012; Coburn et al., 2017).

3.3 Comparison of Curriculum Standards and Guidelines

In examining the frameworks that guide primary science education in Greece and Serbia, it is essential to recognize the broader educational contexts that shape these curriculum standards. Both nations face a rapidly evolving educational landscape that is increasingly marked by the integration of digital technologies, a phenomenon that necessitates a thorough reevaluation of traditional pedagogical approaches previously utilized in the classroom. As outlined in recent research, the importance of incorporating multimedia information literacy into curricula has grown exponentially, representing a significant shift towards connecting necessary digital competencies with robust science education (McDougall et al., 2017). This adaptability is crucial not just for enhancing teaching methods but also for preparing students to be competent learners in a digital world. Furthermore, the need to adapt curriculum standards is increasingly evident in the comparative analysis of how school libraries and information centers contribute to this evolution. Specifically, elements from the Kalsbeek Information Literacy Matrix highlight how strategic reforms in educational facilities and resources can significantly influence student learning outcomes across Europe, emphasizing the integral role of information literacy in enriching and expanding the horizons of science education (Boelens, 2010). This interconnectedness of information literacy and curriculum development illustrates a growing recognition among educators and policymakers of the need for a more cohesive and comprehensive approach to teaching science. Ultimately, both Greece and Serbia are poised to refine their curricula in a meaningful way that ensures they not only meet

local educational needs but also align seamlessly with regional and global standards, fostering a more effective and future-ready learning environment for all students involved.

4. Pedagogical Approaches and Teaching Methods

While both Greece and Serbia strive to enhance their primary science curricula, the pedagogical approaches employed exhibit significant variations influenced by cultural, social, and institutional factors. For instance, Greece incorporates an increasing emphasis on creative pedagogy, where interdisciplinary teaching—particularly the integration of Science and the Arts—aims to engage students more deeply with scientific concepts (Bogner et al., 2019). This innovative integration not only fosters students' creativity but also encourages critical thinking, as educators recognize the importance of applying scientific knowledge within various creative endeavors. This holistic approach helps students develop a well-rounded understanding of science and its applications, effectively bridging the gap between theoretical knowledge and practical experience. In contrast, Serbia's methodologies tend to focus on structured, traditional teaching methods, where the scientific content is often delivered in a more rigid manner, thus limiting opportunities for creative exploration and the application of knowledge in real-world contexts. This divergence highlights the necessity for both countries to reflect on their teaching practices and adapt their pedagogical frameworks accordingly, particularly as interest in STEAM education continues to rise globally. Furthermore, it is critical for educators to examine how these distinct pedagogical approaches affect educational outcomes, student engagement, and motivation in science. By evaluating the effectiveness of current teaching methods and exploring new strategies that promote both creativity and critical thinking, Greece and Serbia can better prepare their students for the complexities of modern scientific challenges (Boelens, 2010). This ongoing reflection and adaptation will ultimately benefit students, ensuring they gain the skills necessary to thrive in an increasingly interdependent world.

4.1 Teaching Strategies Employed in Greek Classrooms

In examining the educational landscape of Greek classrooms, it becomes evident that varied teaching strategies play a critical role in enhancing student engagement and learning outcomes. The integration of intercultural education is particularly noteworthy, as it seeks to foster inclusion among diverse student populations, such as the Roma community, which has historically faced significant educational barriers. This approach not only promotes respect for cultural differences but also actively contributes to building a more cohesive society. Such educational strategies mirror the findings of recent systematic reviews that highlight the importance of valuing cultural diversity and promoting equal opportunities for all students, ultimately aiming to cultivate a nurturing and supportive learning environment for every child, regardless of their background (Berrocal De Luna et al., 2019). Additionally, educational frameworks prioritize experiential learning, allowing students to apply concepts in real-world contexts, thereby fostering a deeper understanding of the material. This methodology of active participation in the learning process is designed to motivate students, thereby mirroring practices in high-performing education systems around the world. By utilizing teacher

assistants from minority backgrounds, schools can create relatable role models for students, which can lead to a significant increase in motivation and achievement, further bridging gaps in engagement and academic success. Such multifaceted strategies not only address current challenges, such as absenteeism and dropout rates, by creating a more inviting atmosphere but also align closely with global metrics for quality education, such as those established by PISA, thereby ensuring that Greek education meets and exceeds international standards of learning and development (PISA, 2012).

4.2 Teaching Strategies Employed in Serbian Classrooms

In Serbian classrooms, educators increasingly emphasize the integration of creativity within science education, aligning with global trends that recognize the significance of interdisciplinary approaches to learning. This emerging educational philosophy not only enhances the engagement of students but also fosters a deeper understanding of scientific concepts by allowing learners to explore the connections between various fields. This perspective is reflected in numerous professional development initiatives aimed at enhancing pedagogical strategies and fostering creative inquiry among students, allowing teachers to share best practices and innovative techniques. Findings suggest that many Serbian teachers view science as inherently creative, a belief that resonates with results from the CREATIONs project, which highlighted that educators across various European contexts similarly perceive this relationship (Bogner et al., 2019). This acknowledgment of creativity's role in science education is crucial, especially considering the existing challenges posed by traditional teaching methods that prioritize rote memorization and standardized testing—practices that often stifle critical thinking and limit student curiosity. Such traditional practices contrast sharply with the aims of the PISA, which advocates for the application of knowledge in novel contexts rather than mere recall of information. This disparity suggests that Serbian educators may need to adopt more innovative teaching strategies and interactive learning experiences to promote genuine scientific understanding, critical thinking, and student engagement (PISA, 2012). Consequently, the evolution of teaching strategies in Serbian classrooms illustrates a complex interplay between entrenched traditional methodologies and the ongoing push for creativity in education, urging educators to find a balance that enriches the educational experiences of their students while preparing them for a rapidly evolving world.

4.3 Effectiveness of Different Pedagogical Approaches

An examination of various pedagogical approaches reveals significant variations in their effectiveness within primary science education, particularly when comparing the educational landscapes of Greece and Serbia. Flipped classrooms, which are characterized by the inversion of traditional teaching methods, have shown promise in enhancing student engagement and accountability among learners. This innovative approach encourages students to take a more active role in their education, allowing them to engage with the material outside of the classroom before applying that knowledge in a collaborative environment. However, the implementation of flipped classrooms faces daunting challenges, such as the need for students' motivation and the accompanying increase in teacher workload

that may arise when adapting to this new format (Salgado-Orellana et al., 2022). In stark contrast, environmental citizenship education emphasizes the crucial role of active civic participation in fostering sustainable attitudes among young learners. This approach suggests that holistic educational frameworks can be particularly effective in cultivating awareness and responsibility toward environmental issues (Hadjichambis et al., 2019). Furthermore, this comparison underscores the importance of contextual factors that influence pedagogical effectiveness; strategies that are thoughtfully aligned with local educational needs and cultural contexts are far more likely to yield favorable outcomes in student learning. Therefore, an integrative approach that thoughtfully combines innovative methods, like flipped classrooms, with established practices of traditional teaching could significantly enhance the overall impact of science curricula in both countries. Such a combination holds great promise for ultimately leading to improved educational experiences for primary students, fostering a generation that is both knowledgeable and environmentally conscious.

4. Discussion

In evaluating the science curricula for primary education in Greece and Serbia, it is crucial to critically assess not only the content but also the broader implications of these educational frameworks on student engagement and creativity in the learning process. The predominant view among educators posits that science is inherently a creative endeavor, a perspective that is echoed by numerous studies suggesting that interdisciplinary approaches, particularly STEAM education, significantly enhance student learning outcomes (Bogner et al., 2019). However, to substantiate this viewpoint, it is essential to analyze the specific elements within these curricula that either promote or hinder creative thinking and problem-solving skills. This understanding highlights the necessity for curricula that are not only effective in imparting scientific knowledge but also intentionally designed to nurture creativity. Moreover, as emphasized in discussions surrounding media and information literacy, adopting a comprehensive approach to education in the digital age is not merely beneficial but essential for cultivating well-rounded learners (McDougall et al., 2017). Therefore, future research should not only investigate how these curricula can be adapted to nurture an educational environment fostering creativity but also critically examine how they can address regional educational challenges and prepare students for a rapidly evolving world that increasingly values innovation and interdisciplinary collaboration.

The consideration of environmental and citizenship education within science curricula emerges as a critical avenue for future curriculum development, particularly in the contexts of Greece and Serbia. Given the increasing urgency of environmental issues, such as climate change and biodiversity loss, it is crucial to assess how effectively integrating components of “Education for Environmental Citizenship” can enhance students’ ability to confront these challenges head-on. This integration should not be taken lightly, as it demands a critical appraisal of existing educational practices and curricula. Aligning this approach with findings from the PISA emphasizes that students should not merely be passive recipients of knowledge; rather, they must engage in applying it to real-world scenarios in a meaningful way. Furthermore, by fostering critical thinking and encouraging pluralistic viewpoints within

the curriculum, educators can empower students not only with scientific literacy but also with the social awareness essential for active citizenship. Therefore, future curricular frameworks should prioritized interdisciplinary connections that facilitate a holistic understanding of science as it relates to societal and environmental interactions. In doing so, we prepare students for informed engagement in their communities, equipping them to critically analyze and respond to the complex challenges that lie ahead.

5. Conclusion

The comparative analysis of science curricula in Greece and Serbia reveals not only significant challenges but also opportunities for enhancing educational outcomes in both nations. In Greece, the current emphasis on inquiry-based learning appears to align well with global educational trends, which should foster critical thinking among primary students (Kotsis, 2024). However, it is crucial to recognize that the implementation of this approach is inconsistent, leading to varying levels of student competencies across different regions; this inconsistency raises questions about the efficacy of educator training and resource allocation. Conversely, while Serbia acknowledges the importance of integrating environmental education into the curriculum, studies indicate that students still lack the comprehensive knowledge required to engage effectively with critical issues such as health and environmental awareness (Stanišić & Maksić, 2014). This gap in understanding calls for a reevaluation of curriculum content and pedagogical strategies. An examination of the PISA further highlights the pressing need for both countries to enhance curriculum relevance and refine teaching methodologies, as these factors are vital for cultivating the skills necessary for active participation in modern societies (PISA, 2012). Addressing these disparities is not merely beneficial but essential for significantly improving the educational frameworks of both Greece and Serbia.

To enhance the effectiveness of science education in primary schools, educators and policymakers in Greece and Serbia should prioritize the integration of inquiry-based learning methodologies, critically examining the potential impact of these approaches on student engagement. Evidence suggests that such methodologies not only foster critical thinking and problem-solving skills in young learners but also encourage them to question assumptions and explore various perspectives. Incorporating hands-on experiments and collaborative projects within the science curriculum can facilitate a deeper understanding and retention of scientific concepts, while prompting students to reflect on their learning processes and the relevance of their findings. Moreover, investment in professional development for teachers is paramount; ongoing training will equip educators with the latest pedagogical strategies and scientific knowledge essential for effective instruction. Policymakers should also consider fostering partnerships between educational institutions and local scientific communities, thus providing a real-world context to the curriculum that encourages students to connect theoretical knowledge with practical applications. Finally, both countries would benefit from a continuous assessment and evaluation of their teaching practices and curricula, which should include critical evaluations of their effectiveness and alignment with international standards, thereby promoting a more cohesive educational framework that prepares students

not only for future scientific challenges but also for a world that requires thoughtful and informed decision-making.

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