A TALE OF TWO CURRICULA: A COMPARATIVE INVESTIGATION OF THE INTERNATIONAL BACCALAUREATE DIPLOMA PROGRAMME AND THE TURKISH MINISTRY OF NATIONAL EDUCATION CURRICULUM FOR HIGH SCHOOL MATHEMATICS

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

This research aims to provide a comparative analysis of the International Baccalaureate Diploma Programme and the Turkish Ministry of National Education high school mathematics curricula. It explores the convergences and divergences of both curricula concerning their educational philosophies, content, teaching and learning processes, and assessment practices. Data were derived from official curricular documents, with a line-by-line examination conducted through open coding techniques. The analysis included interpreting the collected data and examining text by organizing and categorizing codes, phrases, and sentences. By comparing these categories and finding the connections between them, the meaning of the text is concluded and understood. The results indicate that International Baccalaureate Diploma Programme and the Ministry of National Education curricula represent distinct yet comprehensive approaches to Mathematics education, each bringing to bear its unique philosophies, methods, and assessments. Despite their differences, they share a common goal of preparing students for a technologically advanced and globally interconnected 21st-century world, emphasising active learning, real-world applications, and the importance of diverse assessment strategies. This research study's findings may have implications for future curricular reforms and strategies, informing the development of theory-based models for curriculum design.

Keywords: International Baccalaureate, Diploma Programme, mathematics education, comparative analysis, mathematics curriculum.

ÖZET

Bu araştırma, Uluslararası Bakalorya Diploma Programı ile Türkiye Millî Eğitim Bakanlığı lise matematik müfredatlarının karşılaştırmalı bir analizini amaçlamaktadır. Her iki sistemde deneyime sahip bir araştırma odaklı öğretmen perspektifinden, bu müfredatların eğitim felsefeleri, içerik, öğretim ve öğrenme süreçleri ve değerlendirme uygulamaları ile ilgili olarak birleşme ve ayrışma noktaları ortaya çıkarılmıştır. Çalışma verisi resmi müfredat belgelerinden elde edilmiş olup, açık kodlama teknikleriyle satır-satır inceleme yapılmıştır. Verilerin analizi, toplanan verilerin yorumlanması ve kodları, ifadeleri ve cümleleri organize ederek ve kategorize ederek metni incelemeyi içerir. Bu kategorileri karşılaştırarak ve aralarındaki bağlantıları bularak, metnin arka planındaki anlamlar ve bağlantılar ortaya konulmuştur. Bulgular, Uluslararası Bakalorya Diploma Programı ve Milli Eğitim Bakanlığı müfredatının, her birinin benzersiz felsefeleri, yöntemleri ve değerlendirmeleriyle Matematik eğitimine yönelik farklı ama kapsamlı yaklaşımları temsil ettiğini göstermektedir. Farklılıklarına rağmen, her iki program da teknolojik olarak ilerlemiş ve küresel olarak birbirine bağlı bir 21. yüzyıl dünyası için öğrencileri hazırlama ortak hedefini paylaşmaktadır; bu hedef, aktif öğrenme, gerçek dünya uygulamaları ve çeşitli değerlendirme stratejilerinin önemini vurgulamaktadır. Bu araştırmanın bulguları, gelecekteki müfredat reformları ve stratejiler için sonuçlar içermektedir ve teori temelli müfredat tasarım modellerinin geliştirilmesi konusunda araştırmacı ve politika yapıcılara yön gösterebilir.

Anahtar Kelimeler: Uluslararası Bakalorya, Diploma Programı, matematik eğitimi, karşılaştırmalı analiz, matematik programı.

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LIST OF ABBREVIATIONS

OECD: Organization for Economic Co-operation and Development

UNESCO: United Nations Educational, Scientific, and Cultural Organization

IBO: The International Baccalaureate Organization

DP: Diploma Programme,

PYP: Primary Years Program

MYP: Middle Years Program

CAS: Creativity, Activity, and Service.

MoNE: Ministry of National Education

INTRODUCTION

In today's interconnected world, nations struggle with unprecedented economic, environmental, and social challenges. Migration, urbanization, and increasing social and cultural diversity re-shape our world. This situation widens inequalities in living standards while conflict, instability, and populist politics erode trust in institutions (Organisation for Economic Co-operation and Development [OECD], 2018). Rapid advances in science and technology can worsen these disparities and contribute to social fragmentation and resource exhaustion (National Research Council [NRC], 2012). These challenges highlight the role of education at the global level in promoting the common good, national prosperity, and sustainable societies.

In the 21st century, the focus on well-being at the societal level has expanded beyond material resources to include factors such as health, civic engagement, social connections, education, security, life satisfaction, and the environment. Equitable access to these factors underpins inclusive growth and sustainable development, as outlined in the United Nations' 2030 Global Goals for Sustainable Development (United Nations [UN], 2015). Education is essential in fostering the knowledge, skills, attitudes, and values that enable people to contribute to and benefit from a sustainable future. Preparing young people for this uncertain world and preparing them with the skills needed to be responsible citizens is essential for addressing societal challenges (OECD, 2018).

Empowering learners at the individual level to navigate this uncertain world requires fostering a sense of agency, responsibility, and the ability to identify actions. Non-centralized personalized learning environments and solid foundations in literacy, numeracy, digital literacy, and data literacy are vital in this endeavor, as are our physical

health and mental well-being (OECD, 2018). Moreover, a new social contract for education, grounded in human rights, social justice, and an ethic of care, reciprocity, and solidarity, is needed to address injustices and transform the future for individuals (UNESCO, 2021).

This new social contract for education should include school curricula with specific characteristics. For example, the OECD Learning Framework 2030 (OECD, 2018) highlights the importance of designing curricula that prioritize the development of competencies and adaptability. By emphasizing critical thinking, creativity, collaboration, and systems thinking, students can be better prepared to address the complex challenges of modern society. According to the OECD (2018), the curriculum should also be adaptable and dynamic, allowing for updates that reflect evolving societal requirements and individual learning needs while considering all students' diverse needs. By doing so, students from all backgrounds are poised to have an equal opportunity to succeed and contribute to their common good, promoting sustainable societies, national prosperity, and interconnectedness in the global community.

Aligned with influential organizations such as OECD and UNESCO that emphasize a dynamic and adaptable curriculum, William F. Pinar (2011), a prominent curriculum scholar, asserts that teachers must engage in self-reflection and self-discovery to uncover the essence of a good curriculum. Pinar (2011) emphasizes the role of teachers and all practitioners in the organic nature of the curriculum, asserts that curriculum is a living idea, and insists that teachers should be at the forefront of curriculum reform discussions. However, the scholar also acknowledges that the *curriculum-as-process* approach has areas for improvement, including the potential for lack of uniformity in content, varying teaching methods across classrooms, and dependence on teacher quality. Despite these

challenges, the curriculum theorist maintains that a responsive, evolving curriculum is essential for effective education (Pinar, 2011). To further explain this perspective on *curriculum-as-process,* Slattery (2013) emphasizes the importance of incorporating sustainability and holistic teaching methods into the curriculum. He highlights the dual role of education in informing students about issues and promoting practices that contribute to a global consciousness essential for sustainability. Slattery (2013) argues that teachers have a unique opportunity to lead social change on sustainability and survivability, urging them to prioritize these issues in the postmodern discussions of curricula. Ornstein (2009) contends that considering philosophical viewpoints is crucial in curriculum development. He suggests that curriculum designers, particularly those inspired by postmodern perspectives emphasizing the curriculum-as-process approach, can draw inspiration from social contexts. This approach addresses the multifaceted nature of social identities and the distinct requirements of individual learners. By doing so, they can promote democratic values while incorporating the concerns of local communities and the broader society. The curriculum-as-process approach underscores the techniques that enable students to scrutinize reality and devise systems for organizing the knowledge they attain (Ornstein, 2009). Curriculum theorists highlight the existence of diverse curriculum design ideologies, and with a postmodern perspective emphasizing flexible and adaptive curricula, teachers must lead curriculum reform conversations while addressing the interests of local communities and the wider society.

1.1. DIPLOMA PROGRAMME FROM *CURRICULUM AS PROCESS* PERSPECTIVE

The International Baccalaureate (IB) has a rich history deeply embedded in the progressive educational movement of the early 20th century. This movement was

significantly influenced by prominent educators such as Johann Heinrich Pestalozzi, Friedrich Fröbel, and John Dewey, whose ideas laid the foundation for the establishment of the International School of Geneva (Ecolint), considered one of the earliest schools to embrace the idea of international education (Hill, 2012). In addition, Kurt Hahn's four antidotes – fitness training, expeditions, craft projects, and rescue service – played an essential role in shaping the core values of the United World Colleges (UWC) movement and its establishment in the 1950s (Peterson, 2003). Teachers and administrators from Ecolint and UWC helped shape the Diploma Program's (DP) curriculum, structure, and philosophy for senior high school students aged 16-18 before establishing the IB as an organization.

The creation of the DP resulted from a collaborative endeavor involving teachers from several schools worldwide. The teachers' aim in developing the DP program was to create a holistic educational experience that transcended mere knowledge acquisition, intending to nurture well-rounded, empathetic, and engaged global citizens capable of addressing the challenges posed by an increasingly interconnected world (Peterson, 2003). These teachers united to develop an educational program that drew upon progressive principles and Hahn's four antidotes. The need for such a program was twofold: firstly, to fulfill the ideological mission of UWC-Ecolint and other internationally-minded schools, and secondly, to practically ensure university acceptance for their diverse student population (Yagiz et al., 2016).

An experimental period of program development led by teachers started in 1964 and lasted until 1975, initially involving 12 schools. The initial DP featured six subjects, one of which was mathematics at higher and lower levels, with all courses offered in English or French. The program also included a compulsory artistic activity, literature and

philosophy of different cultures, and the study of the Theory of Knowledge (a course on epistemology) introduced in 1970. The Extended Essay was added in 1972, and the Community, Service, Action (CAS) component, aligning with Hahn's ideas, was introduced in 1989 (Hill, 2002). In 1994, the Middle Years Programme (MYP) for students aged 11-16 was introduced, followed by the Primary Years Programme (PYP) for children aged 3-11 in 1997 (Hill, 2012). The IB Mission Statement, which encapsulates the values inspired by Hahn and other progressive educators, was written in 1998 (IBO, 2007).

This unique collaboration among teachers and the continuous evolution of the program allowed the curriculum to draw on diverse perspectives, experiences, and pedagogical approaches, ultimately resulting in a program design that fosters the idea of curriculum as a process (Van Oord, 2007). The progressive principles that informed the IB curriculum include learning by doing, thematic units, community service integration, and emphasizing understanding and action as learning goals instead of rote knowledge (Dewey, 1938). These ideas align with postmodern curriculum designs, prioritizing learning and adaptability over rigid, predetermined content (Van Oord, 2007).

1.2. TURKISH NATIONAL EDUCATION: REFORMS IN PROGRESS

The aims of national education in Turkiye, as stated in the 1739 National Education Basic Law (Millî Eğitim Temel Kanunu)(1973) which is still in motion and administered by the Ministry of National Education [MoNE], are to foster individuals who are committed to Atatürk's principles and the national values of Turkiye, as well as being respectful of human rights, democracy, and the rule of law. The education system aims to cultivate individuals with a balanced and healthy personality, free and scientific thinking abilities, a broad worldview, and a sense of responsibility towards their family, nation, and country. It should be noted that these aims reflect a combination of reconstructionism,

progressivism, and essentialism educational philosophies. The reconstructionist focus on society and its problems is evident, as is the progressivist emphasis on student-centered design and the development of practical skills. Finally, essentialist elements are also evident in focus on teaching national values, human rights, and democracy (Toprakci, 2013; see Ornstein, 2009).

The history of curricular reforms in Turkish national education can be traced back to the early Republican era. During this period, Turkiye underwent a series of sweeping reforms that aimed to modernize the country and establish a new national identity. The first major curricular reform was introduced in 1924, adopting a new secular education system emphasizing science and modernization after the Turkish Ministry of National Education (MoNE) invited John Dewey to analyze and make recommendations for the Turkish education system. Dewey's reports led to increased teacher training, better funding, an overall education plan, and the development of schools as community centers, influencing the curricula of 1930 and 1938 (Ata, 2015). In the following decades, several other reforms were introduced.

In the early 2000s, the Turkish government launched a new initiative to modernize and improve the education system. The first phase of this reform was launched in 2005 and included adopting a new curriculum for primary and secondary education (MoNE, 2005). The second phase of the reform was launched in 2010 and aimed to improve the quality of education by introducing new teaching methods and technologies (MoNE, 2010).

The most recent curricular reforms were introduced in 2017 when the Turkish government launched a new education initiative called Vision 2023 which aims to transform the education system by 2023, the centenary of the Republic of Turkiye. This initiative includes several significant reforms, including adopting a new curriculum

emphasizing critical thinking and problem-solving skills, introducing new technologies and teaching methods, and establishing new vocational schools and training programs (MoNE, 2018).

1.3. MATHEMATICS EDUCATION IN TURKIYE

Argun et al. (2010) state that international influences and reform movements from countries such as the USA, Germany, Canada, and Singapore have shaped mathematics curricula in Turkiye. Early reforms in the 1920s emphasized calculations, mathematical knowledge for other disciplines, reasoning, systematic memory exercises, and post-high school specialization in mathematics while focusing on experimental and empirical techniques. The 1970 curriculum revision introduced modern mathematics in 1976, leading to discussions on generational differences in mathematical viewpoints. According to Argun et al. (2010), the mathematics curriculum development in Turkiye has not always relied on systematic research and experiences. In recent years, mathematics education reforms in Turkiye have aimed to introduce student-centered pedagogies, while the reforms in school mathematics are seen as an opportunity to revitalize the nation and prepare its citizens for the information age (Yolcu, 2021).

Historical analysis suggests that the mathematics curriculum in Turkiye is shaped by cultural theses promoting societal progress, development, order, and stability. These include perceiving and using mathematics in everyday life, developing an aesthetic appreciation for mathematics, enhancing economic efficiency, fostering societal growth, and maintaining social order (Yolcu, 2022). Although, according to the scholar (Yolcu, 2022), mathematics education may appear independent, its underlying function is cultivating responsible, acceptable, and productive citizens.

1.4. CURRICULUM COMPARISON STUDIES

Comparison studies of curricula are crucial for comprehending the intricate interplay between international and national education policies. With globalization shaping education systems worldwide, and considering the influence of international curricula on Turkiye, as exemplified in the case of Dewey during the early Republican era or afterward as outlined by Argun (2010), or by the popularity of IB in Turkiye (Ateskan et al., 2015; Dulun & Lane, 2023; Onur, 2011), it is essential to analyze the convergences and divergences in Turkish mathematics curricula.

Comparative research investigates how international policy impacts education at different levels, fostering a deeper understanding of global interconnectedness and local complexities (Wahlström, Alvunger, & Wermke, 2018). Furthermore, comparing curricula may enable researchers to grasp policy concepts' varied expressions and interpretations as they adapt to sociocultural norms in different contexts, as outlined by Yolcu (2021). However, comparison studies based on documentary analysis, such as curriculum maps, have limitations, as they do not consider the national and cultural values or the social and philosophical contexts in which curricula are often embedded (Hodgen et al., 2013).

Hence, there exists a necessity for practitioners, notably teachers, to assume a more proactive role as researchers of comparative studies. Such investigations allow teachers to contemplate their experiences intricately intertwined with the contextual factors underpinning curricula. This necessity becomes particularly critical and significant when comparing International Baccalaureate (IB) programs, as teachers have played a pivotal role since program development's inception. Therefore, teachers need to assume the role of researchers, actively participating in data collection and analysis as empowered instruments and actively contributing to constructing concepts (Hallberg, 2013). While

such studies in which teachers play a central role frequently exist in the literature (Tusgate, 1996.), interpretivist inquiries are scarce in Turkiye displaying an emerging need. Ultimately, comparison studies of curricula are necessary for developing theory-based models with ground up approaches, which can inform future curricular reforms and strategies from teachers' perspectives (Wahlström & Sundberg, 2018).

1.5. PURPOSE AND RESEARCH QUESTIONS

The present research study primarily aims to compare the IB DP high school mathematics and the Turkish MoNE mathematics curricula from the perspective of a research-informed teacher with experience in both systems to gain insight into the convergences and divergences of these curricula.

Ultimately, the study seeks to inform future curricular reforms and strategies and promote the development of theory-based models for curriculum design that prioritize the development of competencies and adaptability and inform practicing teachers to become agents of change. Accordingly, the study seeks to strengthen the role of teachers in leading curriculum reform discussions, promoting social change on sustainability and survivability, and addressing the interests of local communities and the broader society in the postmodern era. Thus, the following main research question guides this naturalistic and interpretivist inquiry:

How do the International Baccalaureate Diploma Programme (IB DP) mathematics curriculum compare with the Turkish National Ministry of National Education (MoNE) mathematics curriculum?

The study has identified the following four sub-questions:

1. How do the key philosophical underpinnings of the International Baccalaureate Diploma Programme (IB DP) mathematics curriculum and the Turkish National Ministry of National Education (MoNE) mathematics curriculum compare?

2. How does the content of the IB DP mathematics curriculum compare to that of the MoNE mathematics curriculum?

3. In what ways do the teaching and learning processes utilized in the IB DP mathematics curriculum and the MoNE mathematics curriculum differ?

4. How do the assessment practices in the IB DP mathematics curriculum contrast with those in the MoNE mathematics curriculum?

These sub-questions, focusing on philosophy, content, teaching and learning processes, and assessment practices collectively contribute to a comprehensive exploration of the primary research question, providing a detailed comparison between the IB DP and MoNE mathematics curricula.

1.6. SIGNIFICANCE OF THE STUDY

The significance of this study lies in its contribution to a deeper understanding of the convergences and divergences between the International Baccalaureate Diploma Programme (IB DP) and the Turkish National Ministry of National Education (MoNE) mathematics curricula. By comparing these two curricula from the perspective of a research-informed teacher with experience in both systems, the study aims to shed light on the impact of international policies on national education systems and the complexities that arise in adapting curricula to sociocultural norms. This research study's findings may have

implications for future curricular reforms and strategies, informing the development of theory-based models for curriculum design that prioritize the development of competencies and adaptability.

1.7. LIMITATIONS AND DELIMITATIONS

The limitations of this study include the frequent changes in the curricula in Turkiye, which may limit the transferability of the findings to the current state of mathematics education in Turkiye. Additionally, only formal guides and curricula are investigated, which may not accurately reflect teaching and learning practices in the classroom. It should be noted that Turkiye is a vast country with a diverse population, and curricular documents are prepared by the central MoNE, with little input from individual teachers who may have unique circumstances. It should also be considered that this is a naturalistic inquiry, and analyses are conducted from the perspective of a practicing teacher to counter such limitations.

The delimitations of this study include focusing solely on high school mathematics curricula and the perspectives of one research-informed teacher with experience in both the IB DP and Turkish MoNE mathematics curricula. Therefore, the study does not aim to compare the effectiveness of the two curricula or explore student learning outcomes. In addition, the study's findings may not apply to other subject areas or educational contexts beyond high school mathematics and Turkiye.

1.8. DEFINITION OF TERMS

OECD: The Organisation for Economic Co-operation and Development is an international organization that promotes prosperity, equality, opportunity, and well-being through effective policies.

UNESCO: United Nations Educational, Scientific, and Cultural Organization, fosters peace and security by facilitating international collaboration in areas such as education, sciences, culture, communication, and information.

IB-IBO: The International Baccalaureate Organization is a non-profit organization established in 1968 in Geneva, Switzerland. IB provides four rigorous and comprehensive educational programs to a global network of schools to foster a more peaceful and improved world (IBO, 2019).

DP: Diploma Programme, established in 1968, aims to offer an international education that empowers young individuals to navigate the complexities of our world more effectively (IBO, 2015).

PYP: Primary Years Program presents a student-centered, inquiry-based, transdisciplinary curriculum framework that fosters conceptual understanding for children aged 3-12. (IBO, 2015)

MYP: The Middle Years Program is a part of the IB, a cohesive and comprehensive curriculum framework that provides academic rigor and fosters life skills in students aged 11 to 16 (IBO, 2022).

CAS: A central component of the Diploma Programme, encompasses the three strands of Creativity, Activity, and Service. CAS adopts a holistic approach to reinforce and expand students' personal and interpersonal learning from the PYP and MYP (IBO, 2017).

MoNE: Ministry of National Education is the government agency responsible for overseeing and administering the education system in Turkiye.

2. LITERATURE REVIEW

The second chapter presents a broad synthesis of theories and empirical research in curriculum studies, covering perspectives on curriculum philosophies and curricula development. At this early stage of the chapter, a definition of curricula sets the tone for further discussion: According to UNESCO (2015), the curriculum guides all essential aspects of education, determining quality, inclusion, and relevance while fostering social attitudes, skills, and critical thinking necessary for daily life, ultimately awakening individual consciousness through learning experiences. Consequently, the chapter examines several curriculum models and philosophies by thoroughly analyzing general studies. Then, it focuses on the history and evolution of curricula as a social construct. Finally, the chapter explores approaches, theories, and reforms in mathematics education. Overall, the second chapter seeks to clarify the influence of these varied approaches on curriculum implementation by offering a framework for further comparative analysis of the International Baccalaureate Diploma Programme and Turkish Ministry of National Education curricula in mathematics.

2.1. CURRICULUM THEORY AS AN ACADEMIC DISCIPLINE

Curriculum theory represents a separate study of educational curricula. Curriculum theory encompasses an interdisciplinary examination of affordances and experiences related to education (Eisner, 2002). This systematic and critical analysis of educational experiences makes it a field of study with a unique history, a multifaceted present, and an unpredictable future (Ellis, 2004; Pinar, 2014; Snaze, 2010). According to Pinar (2004), in curriculum theory, one can observe influences from various disciplines within the humanities and the arts, and to a lesser degree, from the social sciences, with a particular

emphasis on social theory that explains the actions and behaviors of a society. The field of curriculum theory includes interdisciplinary and social perspectives.

Curriculum theory focuses on *what* rather than *how*. Pinar (2004) explains that curriculum theory focuses on the content and purpose of education; thus, teaching methods are not part of curriculum theory. Curriculum theory emphasizes the importance of understanding *what is being taught* and the implications of the content rather than finding effective ways to deliver knowledge or focusing solely on standardized tests (Ellis, 2004). Such an understanding of the curriculum theory finds its way at the intersection of personal identity and societal context, local and global perspectives, academic subjects, and daily life experiences. As a research field, curriculum theory includes multiculturalism, popular culture, postmodernism, psychoanalytic theory, cultural studies, and research focused on understanding globalization.

"Curriculum theory is...about discovering and articulating, for oneself and with others, the educational significance of the school subjects for self and society in the ever-changing historical moment" (Pinar, 2004, p.16).

Curriculum theory centers on *what* of education, emphasizing content and implications over teaching methods.

2.2. CURRICULUM DEVELOPMENT

The relationship between education and schooling is intricate, necessitating reflection on their meanings. Education in the 21st century demands a shift towards collaboration and interdependence, fostering intellectual character, critical thinking skills, and engaging in meaningful dialogues (Fullan, 2013). Influenced by various theories,

curriculum development is a dynamic process involving multiple stakeholders and approaches. Ultimately, it should focus on promoting intellectual character, active learning, and adaptability to the complexities of the 21st century (Ornstein & Hunkins, 2018).

Throughout the history of curriculum development, various models have influenced its progression. For example, Ornstein and Hunkins (2018) categorize curriculum development approaches broadly into technical models (i.e., modernist, constructivist) and nontechnical models (i.e., postmodernist, post-constructivist). Technical approaches view curriculum development as a blueprint for structuring the learning environment, emphasizing logic, efficiency, and effectiveness with prominent technical models, including those developed by Bobbitt, F., Charters, W. W., Tyler, R. W., Taba, H., Wiggins, G., McTighe, J., Jonassen, D. H., Tessmer, M. Demirel (2013) explains the stance of the technical model scholars (e.g., Taba, H. and Tyler R. W.) that an educational program is a written document or action plan where strategies are determined to acquire desired goals and behaviors. Today, many educators who lean towards behaviorist schools and systems approach share this perspective. For example, Saylor, Alexander, and Lewis (1981) assert that an educational program is designed to provide learning experiences to individuals needing education (as cited in Demirel, 2013).

In contrast, nontechnical approaches focus on subjectivity, personalization, aesthetics, and the learner, with notable models such as the *deliberation model*, *Slattery approach*, and *Doll's four R's approach*. These models highlight the importance of individual learners' experiences in curriculum development, advocating for flexibility and adaptiveness in education (Slattery, 2012; Doll, 1993). In addition, proponents of nontechnical models (e.g., Slattery, P. and Doll, W. E.) emphasize the role of dialogue,

reflection, and critical thinking in the learning process, maintaining that curriculum development should be an ongoing, dynamic process rather than a predetermined, static blueprint.

2.2.1 Technical-Scientific Approach

The technical or the technical-scientific approach to curriculum development, grounded in modernism, emphasizes objectivity, rationality, and certainty. This perspective views knowledge as factual and separate from its creation and learning processes, enabling linear addressing educational objectives. Various curriculum models, such as R. Tyler's *product model* and *learning outcomes curriculum*, also known as *Tyler Rationale* (Madaus & Stufflebeam, 1988) and Wiggins G. and McTighe J.'s (2005) *backward design model*, are associated with this approach.

2.2.2. Nontechnical Approach

The nontechnical approach, synonymous with the postmodern or post-constructivist perspective, prioritizes learners and their subjective experiences over content or learning outcomes. Emphasizing student-centered approaches, this approach adapts to the complexities and intricacies of the world, characterizing education as an *orderly disorder*. By integrating these diverse models into education programs, curriculum developers cultivate holistic and adaptable educational experiences encompassing various curricular topics and pedagogical strategies (Ornstein & Hunkins, 2018).

The deliberation model is, in some way, an example of a postmodern model that exhibits fluidity and focuses on broader, nontechnical concerns to foster a more student-centered learning environment. The deliberation model involves a nonlinear, culturally

contextual process where educators communicate their views on education's goals and content (Schwabb, 1969). From another perspective, this approach blends modernism and postmodernism because it involves six stages: public sharing, highlighting agreement and disagreement, explaining positions, highlighting changes in place, negotiating points of the contract, and adopting a decision (Schwabb, 2013). Thus, the deliberation model offers a viable alternative to technical rationality, emphasizing the importance of a holistic, inclusive approach that acknowledges the complexities of the educational process.

Postmodern curriculum developers prioritize doubt and constant questioning, acknowledging that certainty is momentary and influenced by specific situations. They do not begin with precise directions or endpoints or stages; instead, goals serve as directions for exploration. This approach allows for creativity, inquiry, innovation, and social responsibility, resulting in an adaptive curriculum that evolves with the experiences of students and teachers. For example, P. Slattery's (2006; 2012) guiding principles for postmodern curriculum development emphasize the importance of accepting education's potential for reconceptualization. Slattery (2006) rejects modernist approaches, embraces postmodernism as an emerging approach, studies the curriculum as *current*, and engages in hermeneutics (i.e., the knowledge that deals with interpretation) as a curriculum scholar (Ornstein & Hunkins, 2018). These principles stress the need for educators to respect each student's uniqueness, understand complexity and chaos theory, and recognize the interconnectedness of global and local experiences (Slatterry, 2006). Postmodern curricularists focus on self-analysis, reflection, and interpretation to continually evolve curricula and foster a proper postmodern educational understanding.

Doll (1993, 2008), also a postmodernist, proposes *The Four R's* as an alternative to Tyler's rationalistic approach to curriculum development. Doll's (1993) four R's include

richness, recursion, relations, and rigor. Richness refers to the depth of curricular content and experiences, stimulating continuous learning and intellectual investigation. Recursion involves revisiting and refining ideas, allowing students to add depth and richness to their understanding. Relations highlight the importance of connections within curricular content, pedagogy, and cultural contexts. Lastly, rigor in the postmodern stance is based on interpretation and indeterminacy, drawing from the uncertainty principle of chaos theory. The Four R's offers a framework for evaluating curricula and emphasizes curriculum development's dynamic and evolving nature in both modern and postmodern approaches.

2.3. CURRICULUM PHILOSOPHY

The investigation of educational philosophy necessitates the confluence of two distinct yet interrelated fields: education and philosophy. Yıldırım (1991) contends that the crux of educational philosophy resides in the symbiotic interplay between these domains. According to the scholar, philosophy, as an overarching guiding discipline, steers, refines, and appraises many disciplines, attributable to its comprehensive approach to analyzing problems, facts, and events. Conversely, the multifaceted nature of education manifests through complex aspects, approaches, and dimensions that underscore its complex character. Education's illustrative purpose lies in fostering the growth and edification of individuals by enabling intentional and desired paradigm shifts in behavior (Yıldırım, 1991). Thus, educational philosophy epitomizes the synthesis of philosophical tenets and pedagogical techniques.

Four principal educational philosophies—perennialism, essentialism, progressivism, and reconstructionism—significantly influence schools (Ornstein &

Hunkins, 2018). Each philosophy is rooted in one or more significant philosophical traditions: perennialism in realism, essentialism in idealism and realism, progressivism and reconstructionism in pragmatism, and, to some extent, reconstructionism in existentialism. Ornstein and Hunkins (2018) classify these standpoints into traditional philosophy (perennialism and essentialism) and contemporary philosophy (progressivism and reconstructionism). According to him, these philosophical underpinnings have played a crucial role in shaping mathematics education curricula in the U.S. and globally, reflecting teacher educators' ontological, epistemological, and philosophical perspectives and beliefs. However, it is essential to recognize that these philosophical foundations may change individually, influenced by one's experiences, learning, and personal development.

Perennialism, an enduring and conservative educational philosophy, finds its roots in realism. This philosophy stresses traditional values and knowledge that have withstood the test of time. Robert Hutchins, a perennialism advocate, posits that the aim of education is universal, aiming to improve people in every society (Ornstein & Hunkins, 2018). According to perennialism, the curriculum aims to develop a child's spiritual and mental potential, emphasizing intellectual development, adaptation to universal truth, and responsible freedom (Arslantaş, 2009). Perennialist education systems focus on transmitting a priori knowledge and presenting ideals in the classroom. The curriculum should emphasize universal themes and intellectual topics and maintain logical coherence (Gutek, 2013). Teaching grammar, mathematics, logic, languages, and classical works are popular subjects for a Perennialist education system (Ercan, 2015).

Essentialism constitutes a long-standing theoretical framework concerning the origins of power and order within the natural world. Its central proposition states that nature's laws are inherent within existing natural entities rather than being externally

imposed. Essentialists assert that the behavior of entities is not dictated by divine intervention or even natural laws. Instead, it arises from the innate causal abilities, potentials, and tendencies of their fundamental components and specific arrangement (Ellis, 2002). Essentialism, sharing perennialism's emphasis on mastering skills, facts, and concepts, focuses more on subject matter than students' interests or social issues. Essentialist teaching methods prioritize discipline, training, homework, and serious study. Essentialist teachers are considered masters of their subjects and role models for their students, taking responsibility for the curriculum with minimal student input and maintaining high standards for themselves and their students (Ornstein & Hunkins, 2018). Essentialism, a conservative philosophy, views students not as the center but as elements to be socialized through the curriculum by internalizing cultural values and traditions, thus safeguarding them from new structures and assimilation (Gutek, 2014; Ornstein et al., 2011). The essentialist perspective on education and classroom management leans towards a classical, traditionalist approach, emphasizing discipline and cultural preservation (Berg-Sørensen et al., 2011). Despite its conservatism, essentialism values aspects of scientific management, such as experimentation, observation, and measuring existing situations in education. Its disciplinary approach notably includes using punishment (Terzi, 2008).

Progressivism emerged as a response to perennialist thinking, grounded in pragmatic philosophy and part of a broader social and political reform movement in the early 20th century. Although the progressive movement had various factions, they commonly opposed authoritarian teaching, textbook overreliance, rote memorization, static educational goals, intimidation, and detachment from students' experiences and social reality (Ornstein & Hunkins, 2018). Progressivism emphasizes a learner-centered approach that prioritizes activities, experiences, and cooperative group learning over traditional

education, which is teacher-centered and focused on strict discipline and formality. This educational philosophy promotes active learning while opposing passive human upbringing and competitive individual learning in favor of a more collaborative environment (Şişman, 2007). From progressive educators' point of view, knowledge construction is fundamentally an individualized process, implying that each person creates and structures their understanding uniquely. This process is synonymous with learning, wherein not only is knowledge constructed, but individuals concurrently develop or evolve (Morrison, 2007)

Reconstructionism emerged during the Great Depression, driven by progressive educators who, disillusioned with U.S. society, sought reform. They critiqued progressivism for its overemphasis on child-centered education and bias towards the middle and upper classes, calling instead for a society-centered education inclusive of all social classes (Counts, 1932). This philosophy aligns with perennialism in addressing societal confusion and the need for certainty yet diverges in its forward-looking approach, advocating for consensus on guiding principles for societal transformation rather than returning to historical paradigms (Brameld, 1950).

Counts, G. S. and Brameld, T., key figures in reconstructionism, emphasized the role of education in societal reform. Counts (1932) advocated for schools to address social and economic issues, while Brameld (1950) underscored social responsibility and the necessity for curriculum transformation based on social issues and services. Presently, the Reconstructionist legacy continues in critical pedagogy, which promotes the education of students as informed citizens and agents of societal change, thereby safeguarding democracy. Moreover, critical pedagogy challenges the market-oriented focus in curricula,

advocating instead for education as a public good that fosters a socially aware society (Ornstein & Hunkins, 2018).

2.4. PROGRAM DEVELOPMENT IN EDUCATION

The prevailing opinion among many experts suggests that due to the changing conditions, educational curriculums require continual improvements and necessary adjustments to address any shortcomings (Demirel, 2015: cited by Ünsal and Korkmaz, 2017). According to Marsh (2004), the fast-paced changes of our era necessitate that education curriculums adapt accordingly, which significantly impacts the objectives, content, teaching strategies, and evaluation process in education. Ertürk (1982) suggests that the curriculum development process is primarily designed for trial purposes, and it will only become widespread after the stages of design, trial, evaluation, and correction (Ünsal and Korkmaz, 2017).

In Turkey, due to the continuous need for revisions emerging from necessities, the concept of curriculum development frequently comes into question. The stages of curriculum development; namely, the objectives, content, instructional situations, and evaluation processes of the education curriculum are defined as a whole in the context of variable relationships (Demirel, 2015).

Curriculum development work consists of 5 different stages. Firstly, a necessary needs analysis is conducted, followed by the second stage which involves determining the desired goals for the program and subsequently developing the content, planning learning-teaching experiences, and determining appropriate evaluation tools. The third stage

involves the implementation of the planned pilot education program draft, while the fourth stage is about identifying and evaluating the deficiencies that arise during the pilot implementation. In the fifth and final stage, the deficiencies identified in the pilot program are corrected, and as a result of these corrections, the program should be implemented nationwide (Küçüktepe, 2012).

In addition to this, problem design approaches have gained importance in education. Each design approach carries a philosophy. The basic program design approaches are examined under three main headings: Learner-centered, Subject-centered, and Problem-centered.

- Learner-centered Program Designs have been in the foreground since the 20th century because many program designers have realized that the student is indeed the most critical factor, and each subject needs to be structured according to the learner's age levels. Demirel (2015) explains the learner-centered program design under four subheadings, including Child-centered Design, Experience-centered Design, Romantic Designs, and Humanistic Designs.
- Subject-centered Program Designs constitute a large part of the education programs implemented in schools today, with all elements of the program considered as a whole. This approach consists of four subheadings: Subject Design, Discipline Design, Broad Field Design, and Process Design.
- Problem-centered Program Designs take into consideration the philosophies of reconstructionism and progressivism and are prepared both to meet the needs of society and to teach the cultural and traditional values of society. They emphasize the needs and interests of students (Demirel, 2015). In this design, real-life

situations are taken as the basis, considering the development of the student. It is examined under three subheadings: Life Situation Approach, Core Design, and Reconstructionism Design.

2.5. PRINCIPLES OF THE INTERNATIONAL BACCALAUREATE PROGRAM

During a period of heightened interest in multicultural and global education, the experiences of international schools and the development of the International Baccalaureate (IB) program offer valuable insights. Established in various ways worldwide, these schools have significantly contributed to the development of the IB program, which has influenced their goals, policies, and curricula (Fox, 1985). The symbiotic relationship between international schools and the International Baccalaureate program has been critical to the progress of multicultural and global education.

Established as a non-profit foundation in Geneva, Switzerland 1968, the International Baccalaureate Organization (IBO) initially aimed to facilitate students' international mobility by offering a globally recognized curriculum and diploma qualification (IBO, 2017). Over time, its mission has broadened to make IB education accessible to students of all ages, fostering understanding and appreciation for diverse cultures, languages, and perspectives. Although initially adopted primarily by private international schools, 43% of state schools now offer the IB diploma (Cambridge &Thomson, 2004). The IBO has successfully evolved by providing an increasingly inclusive and internationally-minded education for students across diverse learning environments worldwide. The Diploma Programme (DP) aimed to offer a rigorous and balanced education to facilitate geographic mobility through an internationally recognized university-entrance qualification and foster intercultural understanding and respect. Later,

the IB introduced the Middle Years Programme (MYP) in 1994 and the Primary Years Programme (PYP) in 1997, creating a continuous spectrum of international education for students aged 3 to 19. The addition of the Career-related Programme (CP) in 2012 further enriched this continuum by providing diverse international education pathways for students aged 16 to 19 (IBO, 2019). Thus, the International Baccalaureate Organization has effectively developed a comprehensive and inclusive educational framework catering to students' diverse needs and aspirations worldwide.

The four International Baccalaureate (IB) programs can be implemented individually or in combination, unified by shared values and an emphasis on cultivating lifelong learners capable of positively impacting our complex, interconnected world. This is encapsulated in the ambitious IB mission, which aims to develop inquisitive, knowledgeable, and compassionate young people dedicated to promoting a better, more peaceful world through intercultural understanding and respect. Collaborating with schools, governments, and international organizations, the IB develops challenging educational programs and rigorous assessments that encourage students worldwide to become active, empathetic, and lifelong learners who appreciate diverse perspectives. (IBO, 2019).

The International Baccalaureate (IB) Diploma curriculum, deliberately constructed to possess an international orientation rather than a specific national affiliation, is becoming progressively prevalent in international schools across the globe. The curriculum and its formal external evaluations are accessible in three functional languages: English, French, and Spanish. In addition, to accommodate global educational calendars, schools in the southern hemisphere can administer examinations in November as an alternative to the

standard May examinations taken by international students in international schools adhering to a northern hemisphere schedule (Hayden & Thompson, 2008).

The International Baccalaureate Diploma Programme (IB DP) is designed to provide a holistic educational experience. The curriculum ensures a broad and balanced learning spectrum, with the learner profile and core elements, like the Theory of Knowledge (TOK), the Extended Essay, and Creativity, Activity, and Service (CAS), at its center. These elements stimulate cognitive development and foster active citizenship, challenging students to apply their learning in real-world contexts (IBO, 2015)

In the Diploma Programme, students concurrently undertake six subjects: two languages, one from individuals and societies, one science, one mathematics, and one from the arts or another group. In addition, interdisciplinary subjects like environmental systems and societies, literature, and performance are also offered. This structure permits students to fulfill two subject group requirements with a single interdisciplinary subject, allowing the selection of an additional subject from any group to complete six (Fox, 1985).

The International Baccalaureate Organization (IBO) exemplifies an educational initiative that underscores the importance of critical thinking, particularly within its Diploma Programme (DP), tailored for advanced high school students (Dulun & Lane, 2023).

2.6. FOUNDATIONS OF THE MINISTRY OF NATIONAL EDUCATION

The unified schooling system in Turkiye, affiliated with the Ministry of National Education, was established in 1924 by enacting the Unification of Education (Tevhid-i Tedrisat) law. According to the official ideology of the Republic of Turkiye, the objectives of national education involved reorganizing the schooling systems, curriculum, and

content. Foreign experts such as Dewey J., Künhe, A. Malche, A. and Buyse, Ö. were invited to share their perspectives on the education system during these modifications (Erkilic, Boyaci, & Sonmez, 2017; Kartal, 2017).

The 1924 curriculum, the *1924 Primary School Curriculum (1924 Ilk Mektep Mufredat Programi)*, was designed considering the newly established Republic of Turkiye's educational philosophy, needs, and circumstances. This largely project-based program was implemented for two years. In 1926, the *1926 Primary School Curriculum (1924 Ilk Mektep Mufredat Programi)* was developed, reflecting the country's then-current needs, the characteristics of the children, and progressive global educational understandings. Significantly, the 1926 curriculum included six fundamental principles still foundational to today's curricula (Gözütok, 2003). Although the 1926 program remained in use for a decade, in 1930, a specialized curriculum was developed for rural schools, known as the *Rural Schools Curriculum*, intended to educate rural children according to the specific conditions and needs of their communities based primarily on the principles of the urban schools' curriculum. Fundamental changes in these educational programs were guided by secularism, western orientation, and positive sciences (Koçer, 1974).

Until the 1950s, curriculum development efforts in Turkiye mainly revolved around preparing lessons and subject lists. In the 1948 curriculum, subjects such as history, geography, and civics were grouped under *social studies*; and *natural science* and *agriculture courses* were combined under *science and natural knowledge*, later evolving into *science*. At the National Education Council convened in 1953, primary school curricula were discussed, and the need to enhance the 1948 primary school curriculum was underscored, marking a notable start of curriculum development activities within the

Ministry of National Education. Pilot studies were initiated in Bolu and Istanbul during the years 1953-1954. Also, determining the objectives of primary education at the school level and incorporating research and evaluation concepts into curriculum development and application can be deemed significant steps (Gözütok, 2003).

By the 1960s, curriculum development efforts in Turkiye again concentrated predominantly on primary school programs. During the 7th National Education Council held in 1962, it was decided that contemporary realities and needs should design the curricula; textbooks and resources should be prepared to correspond to curriculum development; teachers should be trained to comply with the new curriculum requirements; a trial program should be developed, reviewed, and implemented for two years across various regions, and after that, expanded to nationwide implementation (Gürkan & Gökçe, 2005).

In 1984, several commissions were established within Turkiye's Ministry of National Education. These commissions comprised subject teachers, MoNE inspectors, and faculty members from university science departments. Post their inception, the first initiative of these commissions was the development of new textbooks. As the 1990s approached, it was observed that special attention was given to Curriculum Development and Assessment within the efforts to restructure our National Education System. On February 28, 1990, during a meeting of the Assessment and Curriculum Development Expert Commissions, specialized commissions for curriculum development were formed in 9 areas, marking the commencement of the respective tasks. (Ünal, Coştu, & Karataş, 2004)

In line with the decisions made at the 18th National Education Council, the educational policies in Turkiye underwent a significant shift in the 2012-2013 academic

year with the adoption of a 4+4+4 education system. The previously implemented system of uninterrupted 8-year compulsory education (5+3) was replaced with a segmented system comprising four years of primary school, four years of middle school, and four years of high school (Güven, 2012). Defined compulsory primary education as the age range of 6-13, and primary education institutions were described as National Education and Teaching Institutions consisting of a four-year compulsory primary school and a four-year compulsory middle school. Furthermore, the decision was made to establish primary and middle schools independently. However, middle schools can also be established jointly with primary or high schools, depending on the available resources and conditions. In addition to these structural changes, the number of instructional hours was altered, and elective courses were added according to different education levels. It was also stipulated that diplomas would only be awarded upon completing 12 years of compulsory education rather than to students completing grades 4 and 8 (MoNE, 2015).

2.7. LEARNING THEORIES IN MATHEMATICS

Jerome Bruner, an influential cognitive psychologist, proposed a cognitive theory of learning, specifically, the stages of representation. According to Bruner (1960), learning progresses through three stages: enactive, iconic, and symbolic. This theory has profoundly influenced teaching methodologies, particularly in mathematics, encouraging the extensive use of hands-on materials or manipulatives. For example, this cognitive-developmental progression can be seen in algebra teaching by combining similar terms.

The van Hiele model (Usiskin, 1982), a widely recognized cognitive theory specific to geometric development, has been the focus of extensive investigation. As per comprehensive qualitative and quantitative research, van Hieles suggested that students undergo five phases or levels of geometric reasoning. Level 0, known as the visualization

stage, is followed by Level 1, the analysis stage, where students start to identify the properties of a shape. Progressing to Level 2, informal deduction, students begin to compare geometric shapes and construct rudimentary proofs. Level 3, termed deduction, involves accepting postulates and theorems and engaging in proof-writing, typically aligning with the traditional teaching approach of high school geometry, emphasizing two-column, paragraph, or indirect proofs. Lastly, Level 4, the stage of rigor, corresponds to students' capacity to operate within alternate geometric systems, such as non-Euclidean geometry, essentially requiring abstract, proof-oriented thinking. The research contributions of van Hieles have incited various proposed modifications in the pedagogy and learning of school geometry. As a result, there has been a noticeable shift in elementary school curricula and textbooks, with an increased emphasis placed on geometric concepts, providing students ample time to nurture and solidify their comprehension of these principles (Fuys, Geddes, & Tischler, 1988)

The constructivist model of instruction, derived from the work of Jean Piaget, advocates for inquiry-based learning, believing it yields more profound and enduring conceptual understanding than traditional lecturing methods. This model comprises three primary principles. Firstly, it posits that knowledge is not simply transferred passively from one person to another; instead, it is internally constructed through life experiences. Secondly, it asserts that students create knowledge not solely through action but also through reflection and discussion, making a hands-on lesson truly constructivist only when paired with meaningful discourse or introspection. Lastly, the model perceives learning as a social process where students exchange ideas about discerned patterns and their understanding of specific problems or concepts (Brahier, 2013).

2.8. TEACHING STRATEGIES IN MATHEMATICS

The National Council of Teachers of Mathematics (NCTM, 2000) has underlined the significance of calculators, computers, and other technological tools as catalysts for initiating discussions in the mathematics classroom, per its Standards for Teaching and Learning Mathematics. A principal axiom from the NCTM's Principles and Standards for School Mathematics, the 'Technology Principle,' asserts that technology is vital for teaching and learning mathematics, as it influences the content taught and augments students' learning. This book has recurrently pointed towards the employment of technology in various aspects, ranging from curve sketching to examining rational and irrational numbers (NTCM, 2000).

According to Goodlad's (1984) research, approximately 80% of a standard class period is dedicated to *teacher talk*, leaving only 20% for students' active engagement in communication. A typical 50-minute mathematics lesson equates to 10 minutes for student participation. Given an average class size of 20 students or more, each student gets only 30 seconds daily to express their thoughts. Considering the constructivist theory that knowledge construction often involves interactions with others, such a limited time for student interaction needs to be improved. Implementation of cooperative learning strategies allows for what is termed as simultaneous interaction, where multiple students can express their thoughts concurrently, thereby fostering a more engaging learning environment.

Contemporary research has demonstrated that cooperative learning strategies substantially influence low-income students more than their high-income counterparts, with a notably higher positive impact on urban students than those in suburban areas (Ginsburg-Block et al., 2006). Therefore, cooperative learning not only generally enhances

academic achievement but also addresses an array of social and psychological objectives. The crux of the matter revolves around the appropriate incorporation of cooperative learning in the classroom. Activities within a cooperative learning environment should be designed to ensure the mandatory active participation of every student in the problem-solving process. Furthermore, individual accountability should be maintained, implying that even though tasks are executed collaboratively, each student must ultimately demonstrate a unique understanding of the concepts through an interview, a written test, or other assessment forms (Brahier, 2013)

2.9. ASSESSMENT IN MATHEMATICS

Brahier (2013) states that formal assessments include pre - and post-tests and homework evaluations, whereas informal assessments involve observing group dynamics, conducting brief interviews with a subset of students, and requesting journal entries. Regardless of their nature, the purpose of assessments remains consistent – to collect data on student performance. The unit test represents a summative evaluation, supplying a conclusive grade that purports to reflect the level of concept mastery by students. However, other methods, such as student presentations at the board, homework correction, and interviews, afford ongoing or formative insights into the unit's progress. Therefore, educators should employ formative and summative assessments to track and confirm student learning effectively.

An open-ended or free-response question is a query that allows for multiple valid responses or a single correct answer derived through various solution paths. Educators utilize these types of questions to gain insights into students' problem-solving cognitive processes and emphasize the value of individual thought processes (Geer, 1988)

Student self-assessments represent a beneficial strategy for evaluating learners' knowledge and cognitive processes, considering that students typically have a profound understanding of their strengths, weaknesses, and inquiries. The self-assessment process can take various forms, including response to writing prompts such as journal entries, administration of brief student surveys, direct questioning of students about their learning styles in interviews, or peer evaluations after a project or unit. Empirical research indicates a significant correlation between student self-assessment and enhanced academic performance (Ross, Hogaboam-Gray, & Rolheiser, 2002).

2.10. RELATED RESOURCES

Upon reviewing the literature, it has been noted that no research directly examining the Turkish Ministry of National Education and the International Baccalaureate Diploma Programme Mathematics curricula could be identified. Nonetheless, several studies are available comparing the MoNE-IB education systems and the education systems of various countries from different perspectives and disciplines. Additionally, studies conducting comparative analyses are also being enlisted. These studies can be briefly enumerated:

Sağlam and Alaçacı's (2012) research undertook a content analysis of chapters focusing on quadratics from Turkiye, Singapore, and the International Baccalaureate Diploma Programme mathematics textbooks. The findings revealed that the Turkish textbook addressed a greater range of learning outcomes for quadratics more thoroughly than the other two. Regarding knowledge organization, the Turkish textbook applied an inductive approach transitioning from quadratic equations to functions. In contrast, Singaporean and IBDP-Standard Level (S.L.) textbooks adopted a deductive methodology, proceeding from quadratic functions to equations. Regarding presentation style, the Turkish and IBDP-SL textbooks offered numerous student-centered activities relative to

the Singaporean textbook. The IBDP-SL textbook, in particular, stood out for its use of real-world applications, technology, and moderate complexity problems, compared to the other two that predominantly utilized low complexity problems.

Dulun's (2018) dissertation employed a comparative case study methodology to probe students' perceptions of readiness for the International Baccalaureate Diploma Programme (IBDP), focusing on students in grades 9 and 10 from three distinct preparatory programs. These included the Turkish national curriculum, the International General Certificate of Secondary Education (IGCSE), and the International Baccalaureate Organisation's Middle Years Programme (MYP).earch explored how each curriculum fostered students' learning strategies, dispositions, and critical thinking skills, gathered through questionnaires, focus group interviews, and examination of students' work samples. The study, grounded on the relevance of these attributes to 21st-century skills vital for a sustainable future, found that students had positive views on their learning experiences across all three preparatory programs. Notably, language classes were credited for fostering independent and creative thinking, while the need to develop communication skills was underscored alongside critical thinking. The study concluded with implications for enhancing IBDP readiness based on student insights, emphasizing the importance of nurturing 21st-century skills like critical thinking and communication to ensure contributions to a sustainable future.

Lu (2019) comprehensively analyses these programs, exploring the similarities and differences between A.P., IB, and the traditional Chinese mathematics program in Ningbo, China. The research also delves into mathematics instructors' perceptions of the newly imported programs. The findings indicate a considerable disparity between secondary and higher education in Chinese mathematics and suggest possible constraints for

individualized learning. In addition, the outcomes highlight the need for curriculum reform and local and non-local teachers to benefit mutually from shared teaching methodologies. Finally, policymakers should tailor the introduction of international programs to local conditions to provide the most appropriate educational experience for Chinese students.

In the doctoral dissertation, Xie (2003) conducts a comparative examination of the National Council of Teachers of Mathematics (NCTM) and Ministry of Education (MOE) national mathematics standards. The research elucidates significant differences. The MOE designs standards focusing on the average student and provides an elective curriculum for advanced learners, whereas the NCTM mandates a uniform mathematical minimum for all students. NCTM advocates for student-led experiential learning, while the MOE prioritizes teacher-directed instruction. Divergences are also evident in curriculum design and the pedagogical theories underpinning these standards. NCTM's curriculum is problem-solving-oriented, supported by progressive learning theory and pragmatism. In contrast, MOE's curriculum aligns with the mathematics and cognitive development structure, grounded in dialectical materialist learning theory.

The study of Erbilge (2019) aims to identify similarities and differences between the Turkish Ministry of National Education (MoNE) middle school mathematics program implemented in grades 5-8 during the 2018-2019 academic year and the Mathematics Teaching Programs in Canada (Ontario) and Hong Kong (China), countries successful in international exams like PISA and TIMSS. Specifically, it seeks to understand if the discrepancy in success arises from program elements (aims, content, teaching, and learning process and assessment). Using document analysis from various sources, this study is patterned in a general scanning model to analyze the similarities and differences between the Turkish, Canadian, and Hong Kong middle school teaching programs. Findings reveal

that all programs aim to foster individuals who can incorporate and apply mathematics into their daily lives. Among the examined mathematics teaching programs, Canada has the most learning outcomes. When these outcomes are linked with the annual teaching hours determined for mathematics teaching, the programs are consistent with teaching hours. In terms of assessment conditions, product, and process-oriented evaluations are crucial in all three teaching programs. While alternative assessment tools in the MoNE program are left to the teacher's creativity or decision, in Canada and Hong Kong, measurement and evaluation tools are specified and customized.

Consequently, the MoNE program needs to be more detailed and diverse in the assessment process than the other two. Thus, the assessment element of the MoNE program could be restructured or enriched considering the format of international exams. In addition, support should be provided for in-service training of current teachers and courses for teacher candidates regarding alternative/complementary assessment methods.

Matthews (2000) evaluates the alignment of constructivist-based and instructivist-based mathematics curricula with the Delaware Content Standards and the National Council of Teachers of Mathematics (NCTM) Curriculum Standards using curricula alignment matrices. The study found that both curricula met state and national standards. To further explore challenges and opportunities associated with implementing standards-based mathematics curricula, Delaware Council of Teachers of Mathematics members were surveyed. The results suggest that while teachers routinely supplement the current mathematics curricula and employ diverse instructional strategies, the curricula are generally aligned with state and national standards.

3. METHODOLOGY

This chapter delineates the research methodology to address the study's research questions. It utilized a qualitative research approach to gain insights regarding the intersections and disparities of various curricula. The research emphasis was confined to pedagogical philosophies, strategies for content delivery, the process of teaching and learning, as well as assessment inherent in senior high school-level curriculum documents. Details regarding the sample selection, data collection procedures, and analysis techniques are included in this chapter.

3.1. RESEARCH DESIGN

This qualitative study employed a research design rooted in the philosophical perspective of naturalistic inquiry, focusing on analyzing curricular documents from the Ministry of National Education Programme (MoNEP) for grades 11 and 12 and the International Baccalaureate Diploma Programme (IB DP). The research utilized grounded theory methodology, which emphasizes the context of the study (Lincoln & Guba, 1985). Description of the grounded theory, according to Lincoln and Guba (1985), as "a general methodology for developing a theory that is grounded in data systematically gathered and analyzed" (p. 342). In addition, this study incorporated interpretive content analysis as its primary method. Interpretive content analysis is an approach that centers on summarizing and interpreting communication content through researcher-derived insights rather than relying on word counts or quantitative analytical techniques. This method entails coding the content's explicit, implicit, or contextual aspects, typically using inductively generated coding schemes (Drischo & Maschi, 2016).

In this study, the problem was identified, and the research questions emerged from that particular problem. The research design allowed the researcher to examine the curricular documents and compare the grade 11-12 MoNEP and IB DP curricula, drawing on her experiences as a teacher of both curricula. In addition, the grounded theory approach enabled the researcher to generate new insights and theoretical understandings of the curricula through systematic data collection and analysis (Lincoln & Guba, 1985).

3.2. SAMPLING

Following the research design, sampling for this study was based on a purposeful selection of curricular documents from the International Baccalaureate Diploma Programme (DP) Mathematics Analysis and Approaches (AA) curriculum and the Ministry of National Education (MoNE) High School Mathematics Curriculum. Purposeful sampling is a qualitative method in which the researcher selects specific cases based on pre-determined criteria relevant to the research objectives (Palinkas et al., 2015). In this study, the purposive sampling of curricular documents was guided by the following criteria:

- Relevance: The selected documents needed to be directly related to the mathematics curricula of both the IB DP and MoNE High School programs.
- Currency: The documents chosen should reflect the most recent versions of the curricula to ensure that the analysis is up-to-date and applicable to current educational practices.
- Completeness: The sampled documents should cover all essential components of both curricula, including educational philosophies, content delivery approaches, learning and teaching processes, and assessment frameworks.

- Accessibility: The documents must be publicly available and easily accessible to ensure a transparent and replicable research process.

- Comparability: The selected documents should provide sufficient information to enable a meaningful comparison between the two curricula, mainly focusing on the last two years (11th and 12th grades) of the MoNE Mathematics Curriculum to align with the two-year duration of the IB DP Mathematics Analysis and Approaches curriculum.

By adhering to these criteria, the researcher aimed to conduct a comprehensive and rigorous document analysis that captures the key aspects of the IB DP and 11-12 MoNE Mathematics curricula and allows for an in-depth comparison.

3.3. DATA SOURCES AND COLLECTION

Adopting a naturalistic paradigm of inquiry, the researcher served as the data collection instrument, using her experiences as a teacher of both MoNE and IB DP curricula to inform the analysis (Lincoln & Guba, 1985). Guba and Lincoln (1994) stated that "the investigator and the object of investigation are assumed to be interactively linked so that the findings are literally created as the investigation proceeds" (p. 111). In this study, the researcher's familiarity with the curricula and personal experiences were instrumental in shaping the analysis and generating new insights.

The data sources for this study consisted of official curricular documents from the International Baccalaureate Diploma Programme (IB DP) Analysis and Approaches Mathematics curriculum and the 11-12 Ministry of National Education (MoNE) High School Mathematics Curriculum. These documents provided the necessary information to

comprehensively compare the two curricula regarding educational philosophies, content delivery approaches, learning and teaching processes, and assessment frameworks.

The International Baccalaureate (IB) Diploma Programme (DP) Mathematics Analysis and Approaches Curriculum is an extensive 94-page document published in February 2019 and most recently updated in November 2020. This curriculum is organized into four main sections: Introduction, Syllabus, Assessment, and Appendices. The entire document served as a data source for this study.

The Ministry of National Education (MoNE) High School Mathematics Curriculum is a 47-page document published in 2018. This curriculum is organized into four primary components: Educational Program, Application of the Educational Program, Structure of the Mathematics Program, and Syllabus for All Grades. For this study, data were collected from 30 pages of the document. The 9th and 10th-grade syllabuses were excluded from the data collection process to facilitate a meaningful comparison.

The curricular documents used in this research included the following sections:

- Official curriculum guides: These sections provide an overview of each curriculum's course objectives, content organization, and learning outcomes. The guides also outlined each program's pedagogical approaches and assessment strategies.

- Syllabus sections: These documents detail the specific topics, concepts, and skills to be covered in each curriculum, the suggested instruction sequence, and any prerequisites for learning. The syllabus documents also included guidelines for teachers on designing and implementing lesson plans in alignment with the curriculum.

- Assessment sections: Assessment materials included sample assessment tasks, rubrics, and guidelines for evaluating student performance in each curriculum. The assessment materials provided insights into the types of assessments used, the weighting of different assessment components, and the expectations for student performance.

- Teacher support materials: These documents provided resources for teachers implementing each curriculum, such as lesson plan templates, suggested teaching strategies, and examples of integrating technology into the learning and teaching process. The teacher support materials also offered guidance on addressing students' diverse needs and fostering a positive learning environment.

- Policy documents: These documents outline the overarching policies and regulations governing the implementation of each curriculum, including the roles and responsibilities of schools, teachers, and students. Policy documents also provided information on each program's accreditation or certification requirements.

By analyzing these curricular documents, the researcher gained a thorough understanding of the key aspects of the IB DP and MoNE Mathematics curricula. This in-depth analysis allowed for a meaningful comparison between the two programs, highlighting their similarities, differences, and unique features. Using official curricular documents as data sources ensured that the research findings were grounded in the most accurate and up-to-date information.

3.4. DATA ANALYSIS

Drawing on the work of Lincoln and Guba (1985), Denzin and Lincoln (2005), and Merriam (1988), this study aimed to examine the similarities and differences between the

MoNE and IB DP curricula, as well as the unique challenges and opportunities presented by each. This qualitative research used analyzed documents to compare the International Baccalaureate Diploma Programme (DP) Mathematics curriculum and the MoNE High School Mathematics Curriculum. Each document was meticulously examined line-by-line, with open coding techniques utilized throughout the process. The analysis included interpreting the collected data and examining text by organizing and categorizing codes, phrases, and sentences. By comparing these categories and finding the connections between them, the meaning of the text can be concluded and understood (Cohen, Manion & Morrison, 2007).

During the initial coding phase, reflective notes and memos were created alongside the development of codes. As a result, 775 codes and memos were generated after the initial reading of both curricula. After completing the coding process, all codes and memos were evaluated, consolidating synonymous codes under one term. This reduction of codes formed the first draft, consisting of 207 codes. Finally, an Excel spreadsheet was utilized to compile all codes associated with their respective texts.

Leveraging the constant comparison method, these codes were subsequently organized into distinct groups, ultimately giving rise to the formation of categories. Thirty categories were created for the first draft. Following the coding and categorizing process, categories were grouped using constant comparison, resulting in four themes. After this process, all the codes, categories, and themes were reviewed, and the number of codes was reduced from 207 to 107, and the number of categories from 30 to 15. See Table 1 for the final version of the categories.

Table 1. *Themes and Categories of the study*

Educational Philosophy	Subject matter and concepts	Teaching and learning process	Assessments
Perennialism	Curriculum Overview	Technology in Teaching and Learning	Assessment types
Reconstructionism	Course Information	Real-world connections	Exam details and question types
Progressivism	Teaching Flexibility	Learner Profile, Student Responsibilities, and Skills	Assessment information, Outline, and marking
Essentialism		Teaching and Learning Approaches	
		Teacher support materials	

According to the data collection process, the IB DP Mathematics Program and MoNE Mathematics Curriculum were compared using four themes, see Table 1 for the themes and respective categories under each theme.

- Educational Philosophy: Both curricula were compared to the four educational philosophies: Perennialism, Essentialism, Progressivism, and Reconstructionism.
- Subject Matter and Concepts: This aspect focuses on Course Information, Curriculum Overview, and Teaching Flexibility.
- Teaching and Learning Process: The curricula were compared into five categories: Approaches to Teaching and Learning, Technology in Teaching and Learning,

Learner Profile and Student Responsibilities, Teacher Support Materials and Real-World Connections.

- Assessment: The Assessment procedures of both curricula were compared according to Assessment Information and Marking, Assessment types, Exam details, and Question types.

Trustworthiness and Working Hypothesis

Trustworthiness, in a comprehensive sense, signifies a wide array of aspects that cumulatively affirm the integrity of qualitative research, akin to the concepts of validity and reliability in the realm of quantitative studies. Within the ambit of interpretive content analysis, the application of trustworthiness is grounded in four key criteria as put forth by Lincoln and Guba (1985) and several other prominent qualitative methodologists (Denzin &Lincoln, 2005; Gonzales, 2004; Merriam, 1988): prolonged engagement with curricular documents, researcher reflexivity, an audit trail and peer debriefing.

- Prolonged engagement: The researcher has been teaching MoNE mathematics curricula for the last seven years and IB curricula for three years, teaching almost exclusively high school mathematics with these curricula. Thus, the researcher spent an extended period examining and analyzing the curricular documents to ensure a comprehensive understanding of both curricula before and during the inquiry. This extended engagement allowed the researcher to identify patterns, nuances, and deeper meanings within the documents, contributing to the credibility of the research findings.

- Researcher reflexivity: Throughout the research process, the researcher maintained a reflexive journal, which documented the analysis process, personal experiences, and potential biases. By engaging in reflexivity, the researcher could identify and address any potential biases or preconceived notions that may have influenced the analysis, ensuring the dependability and confirmability of the findings.

- Audit trail: To further enhance the trustworthiness of the research, an audit trail was maintained, which documented the research process, decisions made, and the rationale for these decisions. The audit trail provided a transparent account of the study, allowing for the examination of the research process by the supervisor, who assessed the credibility, dependability, and confirmability of the research findings. During the data collection and coding phases, the researcher's thesis supervisor conducted an extensive examination of the researcher's data compilation process and coding procedures. Throughout the collaborative process, regular discussion sessions were held, during which the supervisor meticulously verified and confirmed the researcher's findings individually. In addition, the supervisor provided valuable feedback, contributing to the refinement of the researcher's work.

- Peer debriefing: The researcher engaged in peer debriefing sessions with a fellow researcher with similar experience and research context. This collaboration allowed for discussions on methodological issues, interpretations of findings, and potential future directions for the research. The peer debriefer's input served as an additional layer of verification for the research process and findings, contributing to the credibility and dependability of the results.

These measures, along with a rigorous document analysis method and a focus on maintaining the confidentiality of the curricular documents, helped to ensure the

trustworthiness of the qualitative research findings. By establishing trustworthiness, the research provides a reliable and valid comparison between the IB DP Mathematics curriculum and the MoNE High School Mathematics Curriculum, enabling stakeholders to make informed decisions about the respective programs.

Thus, the working hypothesis for this study comparing the International Baccalaureate Diploma Programme (DP) Mathematics curriculum, which is rooted in progressive educational philosophies, and the Ministry of National Education (MoNE) High School Mathematics Curriculum, which aims to foster individuals committed to Atatürk's principles and national values, is as follows:

Significant differences exist between the IB DP Mathematics curriculum and the MoNE High School Mathematics Curriculum regarding educational philosophy, subject matter and concepts, teaching and learning process, and assessment frameworks. These differences may have implications for the effectiveness of each curriculum in preparing students for higher education and their future careers in a global context.

4. RESULTS

In this research study, the aim is to gain insight into the convergences and divergences of the International Baccalaureate Diploma Programme (IB DP) high school mathematics and the Turkish Ministry of National Education (MoNE) mathematics curricula from the perspective of a research-informed teacher who has experience with both systems. Findings will be sequentially presented, initially focusing on the International Baccalaureate Diploma Programme (IB DP), followed by those from the Ministry of National Education (MoNE). To provide readers with an understanding of the researcher's subjectivities, a profile of the researcher is presented at the beginning of this chapter, detailing her background and experiences in International Baccalaureate (IB) programs and the Turkish Ministry of National Education as a mathematics teacher. The chapter then proceeds with a comprehensive analysis comprising four primary themes: educational philosophies, subject matter and content, learning and teaching process, and assessment. Throughout these sections, various aspects of the two curricula are analyzed and compared, such as teaching and learning approaches, learner profiles, supplementary resources for teachers, real-world connections, and the integration of technology into teaching, as well as assessment procedures, criteria, and materials. This exploration allows for a nuanced understanding of each curriculum's unique characteristics, pedagogical approaches, and the commonalities bridging these internationally recognized and nationally implemented frameworks.

4.1. MAIN FINDINGS

4.1.1. Educational Philosophies

The research encompasses an analysis of the educational philosophies embedded within the International Baccalaureate Diploma Programme (IB DP) Mathematics and the Ministry of National Education (MoNE) Mathematics curricula, as presented in the initial theme.

International Baccalaureate Diploma Programme Mathematics

The International Baccalaureate Diploma Programme (IB DP) Mathematics curriculum emphasizes the development of internationally-minded students, highlighting the importance of inquiry and awareness of local and global issues (Hsieh, 2017) The International Baccalaureate Organization (IBO, 2019) stipulates the necessity of a learner profile for students. Within this profile, the significance of international-mindedness is emphatically articulated. Through the analysis of the International Baccalaureate Diploma Programme (IB DP) high school mathematics curriculum, an emphasis on international-mindedness is evident, underscored by recurrent mentions of local and global issues. Moreover, each content segment of the syllabus incorporates a component of international-mindedness. This philosophy of engaging students with global matters, as coded as *local and global issues*, is intrinsically woven into the fabric of the mathematical discipline within this curriculum. As evidence, one of the several sentences directly mentioned in the document is as in the example IBO (2019) said:

> *"One way of fostering international-mindedness is to provide opportunities for inquiry into a range of local and global issues and ideas. This can*

> *enhance their appreciation of the international dimension of mathematics, as well as providing opportunities to engage with global issues surrounding the subject"* (p. 9).

Reconstructionism is an educational philosophy that aims to improve societal well-being by orienting education towards social purposes, embedding issues of global citizenship, and encouraging students to address real-world problems through community service activities (Breithorde & Swiniarski, 1999). The International Baccalaureate Diploma Programme (IB DP) high school curriculum substantively integrates Community, Activity, and Service as core components. In addition, the curriculum persistently highlights local and global issues, aligning closely with the reconstructionism philosophy. As clearly stated in the IB mission statement, the philosophy underpinning the IB DP Mathematics curriculum is mirrored in this reconstructionist pedagogical stance focusing on the development of world citizens.

In addition to the reconstructionist influences observed in the International Baccalaureate Diploma Programme (IB DP) Mathematics curriculum, compelling evidence points towards other philosophical underpinnings. The IB DP high school mathematics document extensively outlines active learning, underscoring the student's role as an integral participant in the learning process. In IB DP high school mathematics curriculum, the following sentences express that the teacher is described not merely as a source of knowledge but as a facilitator who encourages students and fosters a learning environment prepared with inquiry, critical thinking, and problem-solving opportunities.

> *In the IB classroom, students should regularly learn mathematics by being active participants in learning activities. Teachers should therefore provide students with regular opportunities to learn through mathematical inquiry, by*

> *making frequent use of strategies which stimulate students' critical thinking and problem-solving skills.* (IBO, 2019, p.14)

This standpoint closely aligns with the precepts of Progressivism, which is a pedagogical philosophy that prioritizes experiential learning, students' active engagement, and real-world problem-solving (Alkan, 1983).

Ministry of Turkish National Education Programme

In the Ministry of National Education 11 & 12 grades mathematics curriculum context, specific competencies have been identified as required for students. The document highlights the need for students to demonstrate social citizenship competencies alongside cultural and multicultural behaviors in the *competencies* section. Because Perennialism defined the imperative role of education should be to imbue students with enduring cultural and universal values (Ergun, 1996), and Reconstructionism defined as an educational philosophy aimed at articulating and directing education's social purposes toward improving society's collective well-being, with a particular focus on addressing and solving social values and issues (Breithorde & Swiniarski, 1999), this perspective exposes the MoNE's philosophical leanings, indicating a blend of Reconstructionism and Perennialism. Cultural issues and values that the curriculum aligns closely with the principles of Perennialism, which advocates for teaching universal truths and enduring ideas. The emphasis on multicultural matters found in the *Competencies* section of the MoNE Mathematics curriculum guide aligns with reconstructionism as it encourages change in society and global understanding. As a testament to the Reconstructionism philosophies, the MoNE document' *perspective of the curriculum* section unequivocally states that:

> *The fundamental aim of our education system is to nurture individuals equipped with values and competencies that are integrated with knowledge, skills, and behaviors. As knowledge, skills, and behaviors are sought to be imparted through curricula, our values and competencies serve as the connection and horizon that establish the unity amongst these components.* (MEB, 2018)

> *"Eğitim sistemimizin temel amacı değerlerimiz ve yetkinliklerle bütünleşmiş bilgi, beceri ve davranışlara sahip bireyler yetiştirmektir. Bilgi, beceri ve davranışlar öğretim programlarıyla kazandırılmaya çalışılırken değerlerimiz ve yetkinlikler bu bilgi, beceri ve davranışların arasındaki bütünlüğü kuran bağlantı ve ufuk işlevi görmektedir"* (MEB, 2018, p.5).

In the Ministry of National Education (MoNE) 11 &12 grade high school mathematics curriculum, a particular emphasis is placed on national and moral values, along with the cultivation of active citizens who can contribute positively to the socio-cultural development of the country. Additionally, the curriculum emphasizes the importance of students' awareness of their cultural heritage. In the *perspective of the curriculum* section, it is stated that:

> *Our values, distilled from our society's national and spiritual resources, have been transmitted from the past to the present and constitute the inherent legacy that we will pass on to our future* (MEB, 2018).

> *"Değerlerimiz toplumumuzun millî ve manevi kaynaklarından damıtılarak dünden bugüne ulaşmış ve yarınlarımıza aktaracağımız öz mirasımızdır"*(MEB, 2018, p.5).

Analyzing the MoNE document *aim of the curriculum*, it is clear that the curriculum illustrates a combination of Perennialism and Essentialism. Essentialism's influence is evident in its focus on cultivating productive citizens equipped with core values and competencies, a practical approach to education that prioritizes societal contributions. Meanwhile, the Perennialist philosophy emphasizes cultural heritage, suggesting a commitment to enduring cultural values and universal truths that transcend time. As evidence of this point of view in national curriculum, in the document, it is clearly stated that:

> *The secondary education curriculum aims to ensure that students, building on the competencies gained during their primary and middle school years, adopt national and spiritual values, transforming these into a lifestyle. Furthermore, it aims to shape productive and active citizens who contribute to our country's economic, social, and cultural development. Through the "Turkiye Qualifications Framework" and within discipline-specific fields, the curriculum seeks to instill basic skills and competencies, helping students become individuals prepared for a profession, higher education, and life in line with their interests and abilities* (MEB, 2018).

> *"Liseyi tamamlayan öğrencilerin, ilkokulda ve ortaokulda kazandıkları yetkinlikleri geliştirmek suretiyle, millî ve manevi değerleri benimseyip hayat tarzına dönüştürmüş, üretken ve aktif vatandaşlar olarak yurdumuzun iktisadi, sosyal ve kültürel kalkınmasına katkıda bulunan, "Türkiye Yeterlilikler Çerçevesi"nde ve ayrıca disiplinlere özgü alanlarda ifadesini bulan temel düzey beceri ve yetkinlikleri kazanmış, ilgi ve yetenekleri*

doğrultusunda bir mesleğe, yükseköğretime ve hayata hazır bireyler olmalarını sağlamak" (MEB, 2018, p.5).

In conclusion, both the International Baccalaureate Diploma Programme (IB DP) Mathematics and the Ministry of National Education (MoNE) Mathematics curricula display distinct philosophical underpinnings. The IB DP Mathematics curriculum is firmly grounded in Reconstructionism and Progressivism, as evidenced by its emphasis on active learning, a student-centered philosophy, and the development of internationally-minded students. Conversely, the MoNEP Mathematics curriculum embodies an intricate fusion of Perennialist, Reconstructionist, and Essentialist philosophies. The focus on culture, values, and cultural heritage—elements of both Perennialism and Reconstructionism—and the Essentialist accentuation on practical competencies and active citizenship distinguish this curriculum. The curriculum is also committed to multicultural values, substantiating its inclusive and global outlook. These insights shed light on the rich tapestry of philosophical influences that inform these two Mathematics curricula.

4.1.2. Subject matter and content

In this part, this research embarks on an extensive comparative analysis of the subject matter of two prominent Mathematics curricula: the International Baccalaureate Diploma Programme (IB DP) Mathematics and the Ministry of National Education (MoNE) high school Mathematics curriculum. This meticulous examination elucidates each curriculum's unique characteristics and pedagogical approaches while revealing the commonalities that bridge these internationally recognized and nationally implemented frameworks. Furthermore, this comparative analysis allows for a better understanding of how the contents of these curricula are structured to facilitate the development

The International Baccalaureate Diploma Programme Mathematics Analysis and Approaches curriculum incorporates Standard Level (SL) and Higher Level (HL). A significant distinction between these levels pertains to the volume of instructional hours, with SL necessitating a minimum of 150 hours and HL requiring no less than 240 hours (IBO, 2019). In the context of this study, both SL and HL topics were included within the data collection process.

Conversely, in the 11^{th} and 12^{th} grades, the Ministry of National Education High School Mathematics Curriculum is divided into the Elective Foundational Level and Standard Level (MoNE, 2018). The Elective Foundational Level, consisting of 72 instructional hours, primarily reviews 9th and 10th-grade junior high school Mathematics. To the contrary, the Standard Level comprises 216 instructional hours and imparts pre-university mathematical knowledge, such as pre-calculus and trigonometry.

The IB DP Mathematics curriculum contains five topics: Number and Algebra, Functions, Geometry & Trigonometry, Statistics and Probability, and Calculus. These topics are sequentially addressed through Standard Level (SL) and Additional Higher Level (AHL) content. Teachers are expected to cover all SL content for SL students and both SL and AHL content for Higher Level (HL) students. The curriculum is designed to gradually introduce, formalize, and expand on various mathematical concepts. See Table 2 for the ovearall picture.

Table 2. *IB DP Mathematics: Analysis and Approaches syllabus components*

IB DP Analysis and Approaches Syllabus components	Suggested Teaching hours	
	SL	HL
Number and Algebra	19	39
Functions	21	32
Geometry and Trigonometry	25	51
Statistics and Probability	27	33
Calculus	28	55
Toolkit	30	30
Total teaching hours	150	240

All IB DP Mathematics contents are organized into three primary sections. See Table 3. The first section, *Content*, located on the left column of the Table 3, provides a detailed breakdown of the sub-topics to be addressed. The second section, *Guidance, Clarification, and Syllabus Links*, on the right, offers a more nuanced understanding of the specific sub-topics listed in the content section. This helps clarify the examination content and denotes interconnections between various sub-topics within the syllabus. Finally, the third section, *Connections*, provides recommendations for expanded discussion, including real-life applications and ideas for deeper investigation. See Table 3. Potential areas for connections span multiple contexts, including links to other subjects within the DP, the course's aims, international-mindedness, Theory of Knowledge (TOK) discussions, links to teacher support materials (TSM), specimen paper links, the use of technology, suggested websites for instructional or learning activities, and enrichment suggestions for further discussions that may bolster understanding.

Table 3. *Organization schme of the contents*

Content	Guidance, Clarification and Syllabus links
Connections	

Notably, the IB DP Mathematics curriculum offers considerable flexibility regarding the content arrangement. There is no rigid rule regarding the teaching sequence of the topics. This allows teachers to tailor the order of topics based on their school's context, students' profiles, institutional policies, and other pertinent factors, thereby facilitating a customized teaching approach. The IB DP mathematics document clearly states that;

> *"The content of all five topics at the appropriate level must be taught; however, not necessarily in the order in which they appear in the guide. Teachers are expected to construct a course of study that addresses the needs of their students and includes, where necessary, the topics noted in prior learning"* (IBO, 2019, p.19).

The MoNE high school mathematics curriculum content has been structured into learning domains, subdomains, and topics. The learning domains have not been numbered; instead, they are denoted in uppercase. The curriculum comprises three key learning domains: "number and algebra," "geometry," and "data, counting, and probability." learning outcomes have been numerically indexed based on class level, subdomain, topic,

and outcome number. The organization of topics has been presented schematically, providing a clear and systematic understanding of the curriculum structure.

Table 4. *MoNE 11th grade Standard Level Mathematics syllabus components*

11th grade Standard Level Mathematics syllabus components	Suggested Teaching hours
Trigonometry	56
Analytical Geometry	24
Applications of Functions	36
Equations And Inequalities	40
Circle	28
Stereometry	18
Data, Counting and Probability	14
Total teaching hours	216

Table 5. *MoNE 12th grade Standard Level Mathematics syllabus components*

12th grade Standard Mathematics syllabus components	Suggested Teaching hours
Exponential And Logaritmic Functions	36
Sequences	18
Trigonometry	36
Transformations	18
Derivative	46
Integration	42
Analytical Geometry	20
Total teaching hours	216

Table 6. *MoNE 11th grade Elective Foundational Level Mathematics syllabus components*

11th grade Elective Foundational Level Mathematics syllabus components	Suggested Teaching hours
Numbers	18
Triangles	18
Equations and Inequalities	24
Circle	12
Total teaching hours	72

Table 7. *MoNE 12th grade Elective Foundational Level Mathematics syllabus components*

12th grade Elective Foundational Level Mathematics syllabus components	Suggested Teaching hours
Equations and Inequalities	36
Data	10
Measurement	14
Solids	12
Total teaching hours	72

In the Ministry of National Education (MoNE) mathematics curriculum, the sequencing of topics holds substantial significance, mandating teachers to adhere strictly to the order presented in the curriculum. This directive leaves little room for flexibility for teachers and students, requiring all schools to conform to the prescribed arrangement in the curriculum (MEB, 2018). It is explicitly expressed in the curriculum that:

> *... during the program's implementation, the following points should be complied with:*

1. The sequence of learning fields, sub-learning fields, and program topics should be considered the teaching sequence (MEB, 2018).

"...programın uygulanması sürecinde, aşağıdaki hususlara uyulması gerekmektedir:

1. Programdaki öğrenme alanları, alt öğrenme alanları ve konuların sıralanışı, işleniş sırası olarak düşünülmelidir" (MEB, 2018, p.11).

This uncompromising approach prioritizes a pre-defined learning sequence over individualized teaching strategies and pedagogical adjustments, reinforcing the prominence of structure in the MoNE mathematics curriculum.

Both the International Baccalaureate Diploma Programme (IB DP) and the Ministry of National Education (MoNE) mathematics curricula display characteristics of spiral programming in their structures.

In the International Baccalaureate Diploma Program, the order in which subjects are taught can be decided by the teachers. This means they have the freedom to arrange the curriculum in a way that best suits their students' needs. This flexibility is further substantiated by the clear articulation in the curriculum document, which states,

"HL teachers may choose to teach the SL content and AHL content at the same time or teach them in a spiral fashion, by teaching the SL content first and revisiting these topics through the delivery of the AHL topics after this" (IBO, 2019, p.20).

This elucidates the application of spiral programming, as it permits iterative exploration and reinforcement of concepts at increasingly sophisticated levels. Evidence of

this approach within the IB DP Mathematics curriculum is reflected in the syllabus links. For instance, Topic 1.4 pertains to the *financial applications of geometric sequences and series*, which establishes a link with the second topic - *the link to exponential models/functions in topic 2*. Such linkages imply a revisitation and extension of earlier concepts, thus reinforcing the spiral nature of the curriculum.

In alignment with the concept of spiral nature of the curriculum, MoNE Mathematics curriculum embodies a related pedagogical approach. The curriculum states,

> *In line with this aim, on the one hand, learning outcomes that repeat in a spiral approach at different topics and grade levels and explanations are included, and on the other hand, holistic learning outcomes intended to be acquired at once are included* (MEB, 2018).
>
> *"Bu amaç doğrultusunda bir taraftan farklı konu ve sınıf düzeylerinde sarmal bir yaklaşımla tekrar eden kazanımlara ve açıklamalara, diğer taraftan bütünsel ve bir kerede kazandırılması hedeflenen öğrenme çıktılarına yer verilmiştir"* (MEB, 2018, p.4).

This assertion underscores the MoNE curriculum's commitment to iterative revisiting and refining concepts across varying topics and grade levels concurrently with attaining comprehensive, singularly-focused learning outcomes. While the MoNE Mathematics curriculum does not explicitly assert the spiral nature of its structure, discernible signs are evident. An example is seen in the 10th-grade syllabus, where the initial topic focuses on "counting and probability." Subsequently, in the 11th grade, the seventh topic again delves into "data, counting, and probability." This repetition and expansion of the concept denote a spiral approach in the program structure. This structural

strategy of revisiting and expanding upon previously learned concepts signifies the application of spiral programming in both curricula.

4.1.3. Learning and Teaching Process

This section includes a comprehensive analysis of the MoNE and IB DP Mathematics curricula, explicitly focusing on their learning and teaching processes. After a meticulous coding process; five critical categories emerged that epitomized the core aspects of the teaching and learning process. These categories comprise teaching and learning approaches, learner profiles, supplemental resources for teachers, real-world connections, and technology integration into teaching.

4.1.3.1. Teaching and learning approach

The International Baccalaureate Diploma Programme Mathematics curricula explicitly assert the need for students to adopt an active role throughout the learning process. This pedagogical stance is substantiated at multiple junctures within the curriculum, which provides explicit guidelines to educators on fostering a culture of active learning. The IB Mission Statement clearly states,

> *"These programmes encourage students across the world to become active, compassionate and lifelong learners who understand that other people, with their differences, can also be right"* (IBO, 2019).

In IB DP, the key strategy to promote student engagement within the learning process is the integration of the Theory of Knowledge (TOK) into various subtopics, which aids students in critical thinking and articulating their perspectives. Moreover, the curriculum underscores the importance of technology integration, recommending using

Graphing Display Calculators in the classroom to further engage students in the teaching process. Finally, it is explicitly stipulated that the IB DP mathematics classroom should regularly facilitate mathematical inquiry, prompting educators to create frequent opportunities that stimulate students' critical thinking and problem-solving skills, enabling them to participate actively in their learning journey.

In contrast, the Ministry of National Education (MoNE) mathematics curriculum emphasizes the outcomes of the learning process, placing less emphasis on the active participation of learners. The curriculum's *competencies* section stipulates,

> *"Competencies related to citizenship are aimed at equipping individuals with knowledge about social and political concepts and structures, fostering a commitment to democratic and active participation, and facilitating their full integration into civic life"* (MEB, 2018).
>
> *"Vatandaşlıkla ilgili yetkinlik ise bireyleri, toplumsal ve siyasal kavram ve yapılara ilişkin bilgiye, demokratik ve aktif katılım kararlılığına dayalı olarak medeni hayata tam olarak katılmaları için donatmaktadır"* (MEB, 2018, p.4).

Furthermore, MoNE articulates that the mathematics curriculum for 11th and 12th grades aims to enable students to actively utilize mathematics in their daily lives and professional careers after school and to leverage mathematics as an effective analytical tool in their decision-making processes.

The International Baccalaureate Diploma Programme (IB DP) Mathematics curriculum includes various pedagogical approaches within the teaching and learning process context. Fundamental elements of these teaching strategies include conceptual understanding, inquiry-based learning, mathematical modeling, proofs, and technology

integration. These approaches are reiterated and reflected across multiple curriculum sections, emphasizing their significance in learning.

Similarly, MoNE mathematics curriculum outlines several important teaching and learning strategies. It emphasizes the development of problem-solving skills, fostering an appreciation for the discipline and promoting accurate and beneficial use of mathematics. Furthermore, the curriculum encourages students to understand the historical progression of mathematics, recognize the contributions of significant mathematical scholars, and develop an adeptness at identifying and addressing real-world problems using mathematical concepts. These strategies underline the core objectives and pedagogical approaches within the MoNE mathematics curriculum.

The International Baccalaureate (IB) and the Ministry of National Education (MoNE) mathematics curricula underscore a student-centered approach in their pedagogical framework. Nonetheless, the IB curriculum provides more expansive examples within the syllabus that advocate for this approach. Conversely, the MoNE curriculum, while recognizing the importance of student-centered learning, features a relatively limited number of instances within its syllabus that explicitly encourage this methodology.

In the International Baccalaureate Diploma Programme (IB DP) curriculum, the significance of conceptual learning is underscored as a vital component of the syllabus. Twelve concepts and their explanations are written in the curriculum. The concepts are; change, modelling, space, approximation, equivalence, patterns, generalization, quantity, relationships, representation, systems and validity. The curriculum embodies the belief in the potency of concepts, providing detailed explanations for educators. Each topic commences with associated concepts, enabling teachers to instruct all topics using these

related concepts. Numerous instances in the document reaffirm the value of conceptual learning. For example;

> *"In DP mathematics courses, conceptual understandings are key to promoting deep learning. The course identifies twelve fundamental concepts which relate with varying emphasis to each of the five topics"* (IBO, 2019, p.13).

In contrast, within the Turkish Ministry of National Education (MoNE) Mathematics curriculum, each subtopic commences with terms and concepts. However, upon analysis, it becomes evident that the explanations primarily encompass terms, with a conspicuous absence of concepts in the document. For example,

> *Terms and Concepts: directional angle, degree, minute, second, radian, principal measure* (MEB, 2018).
>
> *"Terimler ve Kavramlar: yönlü açı, derece, dakika, saniye, radyan, esas ölçü"* (MEB, 2018, p.32).

4.1.3.2. Learner profile

The MoNE and IB DP Mathematics curricula explicitly outline specific student qualifications. In addition, the expected student qualifications are clearly articulated within the frameworks of both curricula, underscoring the academic standards and competencies students are anticipated to acquire.

MoNE aims to foster individuals with integrated knowledge, skills, and behaviors that form a robust character. The Turkiye Qualifications Framework (Türkiye Yeterlikler Çerçevesi) identifies critical competencies that students will need on both a national and

international scale in their personal, social, academic, and professional lives. These competencies include *communication in the mother tongue and foreign languages*, emphasizing the ability to articulate and interpret concepts, opinions, feelings, and facts in different social and cultural contexts. *Mathematical competence and essential competencies* in science and technology stress the need for practical mathematical thinking for solving everyday problems and utilizing scientific knowledge to define questions and draw evidence-based conclusions. *Digital competence* involvesthe safe and critical use of information communication technologies while *learning to learn* focuses on organizing one's own learning process, individually or in groups. *Social and citizenship-related competencies* are pivotal, encompassing interpersonal and intercultural competencies and equipping individuals to participate effectively and constructively in diversified societies and workplaces. The *initiative-taking* and entrepreneurship competency underscores the capacity to turn thoughts into action, involving creativity, innovation, risk-taking, and project management. Lastly, *cultural awareness* and expression appreciate the importance of creatively expressing views, experiences, and emotions using various mass communication tools, including music, performing arts, literature, and visual arts.

The International Baccalaureate Diploma Programme (IB DP) advocates for the comprehensive development of a learner through ten principal attributes outlined in the Learner Profile. These attributes integrate an array of skills and mindsets. The students are encouraged to be inquisitive, fostering independent and collaborative research and learning skills. They are envisioned to be *knowledgeable* across various disciplines and engaged with local and global issues. As *thinkers*, they harness critical and creative thought processes to handle intricate issues, making ethical and reasoned decisions. They are *communicators* who confidently express themselves in multiple languages and

collaborative contexts while respecting diverse perspectives. Upholding *principles* of fairness, justice, respect, and personal accountability forms another core attribute. *Open-mindedness*, characterized by the appreciation of personal and others' cultural backgrounds, values, and traditions, and a willingness to learn from diverse experiences, is also underscored. Further attributes include *caring*, demonstrating empathy, compassion, and a commitment to service; being risk-takers who confront uncertainties courageously and resiliently; being *balanced*, acknowledging the need to harmonize intellectual, physical, and emotional aspects of life for personal and communal well-being; and being *reflective*, considering personal ideas, experiences, strengths, and weaknesses to support their learning and personal development.

In the Ministry of National Education (MoNE) curriculum, student's expected competencies are not emphasized within the grades 11 and 12 Mathematics syllabus. There is no evidence found regarding these skills in the MoNE Mathematics curriculum. Conversely, within the International Baccalaureate Diploma Programme (IB DP) Mathematics curriculum, multiple sections have been found that contribute to the learner profile. These include international-mindedness connections, real-life connections, and the Theory of Knowledge.

4.1.3.3. Supplemental resources for teachers

Supplementary resources play a crucial role in instruction, providing teachers with flexibility and potential sources of guidance and inspiration during the teaching process. The International Baccalaureate Diploma Programme (IB DP) curriculum provides additional resources and teacher support materials. These resources cater to various elements of the curriculum, including Creativity, Activity, Service (CAS), Theory of Knowledge (TOK), Internal Assessment (IA), and Extended Essay (EE), offering detailed

guidelines for educators. These supplementary materials are frequently referred to throughout the IB DP Mathematics curriculum. It is clearly stated that;

> *"Additional publications such as specimen papers and markschemes, teacher support materials, subject reports and grade descriptors can also be found on the programme resource centre. Past examination papers as well as mark schemes can be purchased from the IB store"* (IBO, 2019, p.70).

Moreover, teachers are given access to relevant templates, which can be downloaded for classroom use. For instance, a "connections" template is provided at the end of each content section, intended to facilitate links to other contexts, real-world applications, and other subjects.

Conversely, the Ministry of National Education (MoNE) Mathematics curriculum does not provide detailed explanations or supplementary instructional resources, contrasting the approach in the International Baccalaureate Diploma Programme (IB DP) curriculum.

4.1.3.4. Real-world connections

The International Baccalaureate Diploma Programme (IB DP) Mathematics and the Ministry of National Education (MoNE) Mathematics curricula emphasize real-world connections' significance in students' learning process. The IB DP curriculum fosters this perspective by integrating connections with real-world situations, modeling, and conceptual understanding. Additionally, the curriculum includes examples related to real-world scenarios, typically located within the "other contexts or links to other subjects" section. For instance, within the topic "Laws of exponents with integer exponents," the Richter scale is presented as a real-world connection in the relevant context section. In the

IB DP mathematics curriculum, numerous examples of real-world connections have been discovered, such as;

> *"Links to other subjects: pH, buffer calculations and finding activation energy from experimental data"* (IBO, 2019, p.32).

> *"Other contexts: Concepts in electrical engineering—impedance as a combination of resistance and reactance, also apparent power as a combination of real and reactive powers"* (IBO, 2019, p.34).

> *"Links to other subjects: Exchange rates and price and income elasticity, demand and supply curves (economics); graphical analysis in experimental work (sciences group subjects)"* (IBO, 2019, p.37).

In contrast, the MoNE Mathematics curriculum routinely includes the statement "real-life examples are included" in many context explanations. However, a detailed curriculum analysis reveals insufficient evidence, such as specific examples, to substantiate these assertions. See Table 8.

Table 8. *Frequency table of words about real-world connection*

Words	IB DP	MoNE
Real life	**14**	**24**
Real world	**17**	**0**
Links to other subject	**50**	**0**
Other context	**28**	**0**
Total	**109**	**24**

4.1.3.5. Use of technology

The International Baccalaureate Diploma Programme (IB DP) and the Ministry of National Education (MoNE) Mathematics curricula incorporate technology within their respective syllabi. In its curriculum, MoNE emphasizes competency in science and technology, encompassing the understanding of changes arising from human activities and the power to grasp each individual's responsibilities as a citizen. The MoNE mathematics syllabus also provides numerous technology integrations within the teaching process. However, the application of technology appears to be confined primarily to the teaching process, with no explicit evidence of its utilization in the learning process. Although MoNE allows teachers and students to use technology, the document does not specify any types of technology or give examples. It is expressed that;

> *Digital competency, as the curriculum outlines, encompasses the safe and critical use of information and communication technologies for work, daily life, and communication. This proficiency is supported by fundamental skills such as utilizing computers to access, evaluate, store, produce, present, and exchange information, participate in shared networks, and establish communication via the Internet* (MEB, 2018).

> *"Dijital yetkinlik: İş, günlük hayat ve iletişim için bilgi iletişim teknolojilerinin güvenli ve eleştirel şekilde kullanılmasını kapsar. Söz konusu yetkinlik, bilgiye erişim ve bilginin değerlendirilmesi, saklanması, üretimi, sunulması ve alışverişi için bilgisayarların kullanılması ayrıca internet aracılığıyla ortak ağlara katılım sağlanması ve iletişim kurulması gibi temel beceriler yoluyla desteklenmektedir"*(MEB, 2018, p.7).

Similarly, the IB DP mathematics curriculum highlights the critical role of technology in teaching and learning processes. Teachers can utilize technology to enhance students' understanding, address misconceptions, aid visualization, and support students in forming conjectures and checking generalizations. It is clearly stated that;

> *"Teachers should create a learning environment in which students are comfortable as risk takers, and inquiry, conceptual understanding, collaboration, and use of technology feature prominently"* (IBO, 2019, p.19).

Simultaneously, students can use technology to enhance their conceptual understanding, test conjectures, justify interpretations, collaborate on projects, and organize and analyze data. In the classroom, both teachers and students can use technology individually or collaboratively to explore mathematical concepts. A balanced approach between teacher and student use of technology is essential to successful mathematics learning. Various technological tools are suggested to support teaching and learning, including graphical calculators, dynamic graphing software, spreadsheets, simulations, dynamic geometry software, and interactive whiteboard software.

Teachers are expected to facilitate a gradual shift towards student independence in inquiry and thinking. The learning environment should encourage students to be risk-takers, placing a strong emphasis on inquiry, conceptual understanding, collaboration, and the use of technology.

While the term "technology" in the curriculum encompasses all forms of calculators, hardware, or software, there are restrictions on the specific technology allowed in examinations. In the International Baccalaureate Diploma Programme (IB DP), the assessment component, a critical facet of the program, incorporates two or three

examination papers depending on the specific subject and the level of students' engagement. In particular papers, the use of graphing calculators is mandated. As per the IB policy, various calculators are sanctioned for utilization. Before the examination, these calculators must be set to exam mode, as detailed in the provided supporting material. This mandatory requirement underscores the stringent adherence to academic integrity and fairness in the examination process. The *Assessment Objectives* part states that;

> *"Technology: Use technology accurately, appropriately and efficiently both to explore new ideas and to solve problems"* (IBO, 2019, p.19).

4.1.4. Assessment of student's learning

This section conducts a meticulous comparative analysis of the assessment procedures in the International Baccalaureate Diploma Programme (IB DP) Mathematics curriculum and the Ministry of National Education (MoNE) Mathematics curriculum. This analysis focuses on several parameters, including the assessment criteria, the nature of examination questions, and the materials utilized for assessment purposes.

4.1.4.1. Assessment procedures

The primary assessment objective in the IB DP is to support curricular goals and foster suitable student learning through external and internal assessments. International Baccalaureate examiners mark external assessments, while internal assessments are evaluated by teachers and externally moderated by the IB.

The IB DP recognizes two types of assessment: formative and summative. Formative assessment aims to provide accurate feedback for students and teachers to

improve understanding and capabilities and enhance teaching quality by monitoring progress toward meeting course objectives.

The DP primarily concentrates on summative assessment, which focuses on measuring student achievements at or near the end of a course. Nonetheless, many assessment instruments can be employed formatively during teaching and learning, and educators are encouraged to utilize them in this manner. Therefore, a comprehensive assessment plan is integral to teaching, learning, and course organization.

The IB DP adopts a criterion-related approach to assessment rather than a norm-referenced approach, assessing students' work based on their performance to established levels of attainment rather than in comparison to other students.

In the context of the Ministry of National Education (MoNE) mathematics curriculum, the uniqueness of every individual necessitates and flexibility in the assessment process that opposes a "one-size-fits-all" approach. This perspective dictates that curricula should serve as guiding blueprints rather than definitive sources for all assessment elements, thus placing the burden of effectiveness not on the curriculum but on teachers and educational implementers. The essence of this approach is the expectation for originality and creativity from educators, considering the diverse internal and external dynamics such as individual characteristics, educational level, course content, social environment, and school facilities, among others.

From this viewpoint, the principles guiding assessment procedures in MoNE curricula can be summarized as follows: Assessment work should be maximally consistent with all curriculum components, considering the boundaries of acquisitions and explanations. Assessment practices are integral to education and are carried out throughout

the educational process. Individual differences necessitate diverse assessment methods rather than a standard one-size-fits-all approach, and academic development cannot be measured and evaluated through a single method or technique. Lastly, considering the dynamism of individuals' interests, attitudes, values, and achievements, measurements that consider changes over time are favored over one-time assessments.

4.1.4.2. Assessment criteria

In the IB DP, the context of open-ended assessment tasks and assessment criteria serve as the critical tool for evaluating student performance, focusing on specific skills that students are anticipated to demonstrate. Assessment objectives outline what the students are expected to accomplish, while assessment criteria gauge how proficiently they should be able to accomplish it. Using such criteria promotes differentiation among diverse responses and stimulates various responses. Each criterion is characterized by hierarchically arranged level descriptors, with each descriptor corresponding to one or more marks.

The application of each criterion is carried out independently, utilizing a best-fit model, and the maximum marks attributed to each criterion can vary, reflecting the relative importance of the criterion. Upon evaluating a piece of work, the marks conferred for each criterion are summed up to derive the total mark for that particular work. This assessment model allows nuanced evaluation and fosters a multi-faceted approach to demonstrating understanding and skill proficiency.

Contrary to the IB DP Mathematics curriculum, the MoNE Mathematics curriculum does not stipulate specific assessment criteria for open-ended tasks assigned to students. Instead, educators are anticipated to construct their criteria for these tasks, contingent upon

their students' unique profiles and pre-existing knowledge. In its present form, the curriculum does not incorporate specific instruments or guidelines for establishing assessment criteria. This approach reflected a greater emphasis on teacher autonomy and contextualized assessment practices catering to individual students' needs and abilities.

4.1.4.3. The nature of examination questions

In the International Baccalaureate Diploma Programme (IB DP) Mathematics curriculum, students are subjected to two or three paper examinations based on their academic level. The content and type of questions in these examinations exhibit variability, with Paper 1 and Paper 2 encompassing short-response and extended-response questions, all of an open-ended nature. Paper 3, exclusively attempted by Higher Level (HL) students, involves questions requiring extended responses that entail sustained reasoning. These questions are centered around a single theme emphasizing problem-solving leading to a generalization or the interpretation of a context. Questions may be articulated in various forms, such as words, symbols, diagrams, tables, or a combination thereof. Generally, each question in Paper 3 reflects a gradation in difficulty, starting from relatively easy tasks and culminating in more challenging tasks towards the end, emphasizing the notion of problem-solving.

Unlike the International Baccalaureate Diploma Programme (IB DP), the Turkish Ministry of National Education (MoNE) Mathematics curriculum does not culminate with an end-of-year examination. Instead, the MoNE Mathematics curriculum assesses students throughout the years, leading to graduation based on formative assessments. Although the specifics of these evaluations are not explicitly stated in the curriculum, it is customary knowledge among educators that two exams per term are conducted, and these exam results, along with students' overall performance, are factored into grading. However,

thorough curriculum document analysis finds no specific information about this evaluation process.

4.1.4.4. Assessment materials

The Ministry of National Education (MoNE) Mathematics curriculum offers flexibility to teachers concerning assessment tools, refraining from imposing strict boundaries. As explicitly stated in the curriculum, it does not prescribe stringent limits for educators regarding the measurement tools and methods that could be used during the evaluation process; instead, it merely provides guidance. Nonetheless, it is emphasized that chosen evaluation tools and methods should adhere to necessary technical and academic standards. It is clearly stated that;

> *The curriculum does not set definite boundaries for the practitioners regarding measurement tools and methods that can be used in the measurement process, and it only guides them. However, the preferred measurement and evaluation tool and method should comply with the required technical and academic standards* (MEB, 2018).

> *"Öğretim programı, ölçme sürecinde kullanılabilecek ölçme araç ve yöntemleri açısından uygulayıcılara kesin sınırlar çizmez, sadece yol gösterir. Ancak tercih edilen ölçme ve değerlendirme araç ve yönteminde, gereken teknik ve akademik standartlara uyulmalıdır"* (MEB, 2018, p.8).

On the other hand, the International Baccalaureate Diploma Programme (IB DP) Mathematics curriculum underscores the compulsory use of certain materials during examinations, specifically graphic display calculators and formula booklets. Therefore, it is

incumbent upon the school to provide students with copies of these formula booklets during examinations.

4.1.5. Final remarks

In conclusion, the International Baccalaureate Diploma Programme (IB DP) Mathematics and the Ministry of National Education (MoNE) Mathematics curricula are unique in their philosophical bases, structure, teaching methods, integration of real-world applications, technology usage, and assessment strategies. The IB DP Mathematics curriculum is founded on Reconstructionism and Progressivism, emphasizing active student learning, whereas the MoNE Mathematics curriculum combines Perennialist, Reconstructionist, and Essentialist philosophies, focusing on cultural heritage and practical skills. Both curricula use a spiral programming structure and underscore the importance of making real-world connections.

In terms of pedagogical methods, the IB DP encourages conceptual understanding, inquiry-based learning, mathematical modeling, proofs, and technology integration. Meanwhile, the MoNE curriculum stresses problem-solving skills, appreciation of the discipline, and practical side of mathematics. Both programs integrate technology into their syllabi to enhance learning experiences.

Regarding assessment, the IB DP uses a combination of external and internal assessments to support curricular goals and promote indepth student learning. On the other hand, the MoNE emphasizes the need for diversity and flexibility in the assessment process, rejecting a *one-size-fits-all* approach and placing the responsibility of effective implementation on educators. Overall, these observations reveal a rich blend of

philosophical influences and approaches in these two Mathematics curricula, both aiming to prepare students for the demands of the 21st century.

5. DISCUSSION

This concluding chapter begins with a dissertation restatement, revisiting the study's objective, research context, and methodological approach. It then proceeds to an in-depth exploration of the primary findings and their corresponding observations supported by a relevant literature review. Finally, after an exhaustive discussion of these results, the chapter delves into this study's practical and research implications.

This study investigated the comparison of the Turkish Ministry of National Education and IB DP high school mathematics curricula. The study focused on these two curricula' philosophy, content, teaching and learning process, and assessment strategies. The principal method employed in this study is interpretive content analysis, a technique centered on the summarization and interpretation of communicated content. It emphasizes researcher-driven insights. Furthermore, the method involves coding the content's explicit, implicit, or contextual aspects, commonly using inductively created coding schemes (Drischo & Maschi, 2016).

The research problem was established in this inquiry, and the research questions emanated from it. The adopted research design facilitated a thorough examination and comparison of the MoNE and IB DP curricula, leveraging the researcher's experiences teaching both curricula. The evidentiary bases for this investigation were official curricular documents drawn from the International Baccalaureate Diploma Programme's Analysis and Approaches Mathematics curriculum, alongside those of the Ministry of National Education’s High School Mathematics Curriculum. These documents furnished the requisite information for an in-depth comparative analysis between the two curricula,

encompassing educational philosophies, subject matter and content, learning and teaching process, and assessment frameworks.

5.1. SUMMARY OF THE MAJOR FINDINGS

5.1.1. Finding about Educational Philosophies

In the International Baccalaureate Diploma Programme, high school mathematics curriculum, a philosophy of cultivating student-centered global citizens, is prominent. In contrast, the national high school mathematics curriculum of the Ministry of National Education (MoNE) emphasizes national values and competencies, along with a noticeable accent on cultural heritage within education.

This result could be attributed to the two programs' differing foundational goals and perspectives. The International Baccalaureate Diploma Programme (IB DP), designed as a global program, strives to foster internationally-minded learners who can navigate diverse cultural landscapes. It promotes a sophisticated approach to education, emphasizing critical thinking, intercultural understanding, and active citizenship (Clifforda & Montgomery, 2019). On the other hand, the Ministry of National Education (MoNE) curriculum is national in its scope, with the responsibility of instilling national values and competencies in students. It aims to preserve and transmit cultural heritage, foster patriotism, and develop proficient citizens who can contribute effectively to the nation's socioeconomic growth. Therefore, the curricula's distinct objectives inherently reflect their contrasting philosophies.

5.1.2. Finding about subject metter and content

In both curricula, traces of a spiral curriculum design can be identified. However, the International Baccalaureate Diploma Programme, high school mathematics curriculum, provides teachers with greater flexibility than the high school mathematics curriculum of the Ministry of National Education.

This distinction may be attributed to the two curricula' contrasting educational ideologies and teaching models. The International Baccalaureate Diploma Programme emphasizes a learner-centered, inquiry-based approach, providing a broad scope for teachers to tailor their instructional strategies to students' diverse learning needs. This flexibility in the curriculum design could help teachers adopt differentiated and individualized pedagogical practices, thereby maximizing student learning outcomes. Conversely, the Ministry of National Education curriculum might adhere to a more standardized, structured approach in its design, reflecting a focus on uniformity and consistency across different educational contexts. This could ensure that all students, regardless of location or educational institution, gain the same knowledge and skills in line with national education objectives. Hence, the MoNE curriculum's relative rigidity compared to the IB DP's flexibility reflects their differing pedagogical priorities (Tomlinson & McTighe, 2006).

5.1.3. Finding about Teaching and Learning Process

The International Baccalaureate Diploma Programme (IB DP) is perceived as a curriculum intensely concentrated on the learning and teaching process. At the same time, the Ministry of National Education is observed to focus on learning outcomes.

Despite both curricula showcasing learner-centered approaches, the IB DP syllabus contains more evidence supporting this approach, whereas such evidence is less noticeable or absent in the MoNE program. Both curricula delineate learner profiles. The International Baccalaureate Diploma Programme (IB DP) articulates its learning and teaching approaches in great detail to support its learner profile. In contrast, the Ministry of National Education shows scant evidence for its defined learner profile. Both curricula incorporate the use of technology and underscore its importance. The International Baccalaureate Diploma Programme (IB DP) presents a more detailed account of this integration. In contrast, the instances are comparatively less frequent in the Ministry of National Education curriculum.

The distinct observations noted between the International Baccalaureate Diploma Programme and the Ministry of National Education can be contextualized by considering the educational frameworks and the respective backgrounds of their curriculum developers that guide each program. For example, the IB DP emphasizes the learning and teaching process, with its developers primarily emerging from teaching backgrounds. This focus aligns with its constructivist learning paradigm, which advocates for individual knowledge construction and deep conceptual understanding (Cobern, 1993). It is also substantiated by the wealth of examples found within its curriculum. In addition, the background of the IB DP's curriculum developers might facilitate a nuanced understanding of classroom dynamics, thereby enhancing the relevance and applicability of the examples provided.

Conversely, the MoNE's focus on learning outcomes can be linked to its the traditional, outcome-based educational vision that seeks to ensure students meet predetermined performance benchmarks. As academic and administrative professionals

primarily devise the MoNE curriculum, learner-centered approaches, and real-world applications need to be more plentiful (Spady,1982). This relative lack could be attributed to the curriculum developers' different professional experiences and perspectives, which might not be as intimately connected with the realities of classroom teaching as in the IB DP. These varying emphases in the two curricula might also reflect the distinct socio-cultural, economic, and educational contexts in which they are rooted.

5.1.4. Finding about Assessment

The International Baccalaureate Diploma Programme demonstrates a broad spectrum of assessment types, comprehensively explaining summative and formative assessments. In contrast, the Ministry of National Education presents a more superficial assessment description. It provides a framework that emphasizes educators' need to shape this by their specific conditions.

The observed discrepancy between the International Baccalaureate Diploma Programme (IB DP) and the Ministry of National Education regarding the breadth and depth of assessments can be ascribed to their varying educational priorities and pedagogical philosophies. The IB DP, with its comprehensive and detailed explanation of assessment types, including both summative and formative methods, reflects an educational philosophy that heavily emphasizes continuous, multi-faceted student evaluation, aligning with its learner-centered and holistic educational approach (Scherer & Gustafsson 2015). In contrast, MoNE provides a more generalized assessment framework, potentially reflecting its focus on learning outcomes and adapting teaching and assessment methods to local educational contexts. This approach perhaps allows for greater teacher autonomy, considering the diverse circumstances and needs of the educational environments within the national context.

5.2. TEACHER'S PERSPECTIVE OF FINDINGS

From a teacher's perspective, the alignment of the International Baccalaureate Diploma Programme (IB DP) with the Progressivism philosophy of education is evident. This philosophy, characterized by a student-centered approach and active learning, is deeply ingrained within the framework of the IB DP. The teacher's role in this context transcends conventional instructional parameters, evolving instead into guidance and mentorship. Furthermore, the teacher is instrumental in establishing a dynamic, interactive learning environment that amplifies student agency. This interactive pedagogical setting encourages students to take ownership of their learning journey, highlighting the progressivist philosophy at the heart of the IB DP.

On the other hand, the Ministry of National Education (MoNE) Mathematics curriculum, as viewed from an educator's perspective, reflects a unique integration of Perennialism and Reconstructionism. The curriculum places significant emphasis on cultural values and active citizenship. It simultaneously embraces enduring values of the past while preparing students for future challenges, thus demonstrating a balanced approach. Furthermore, the curriculum firmly embeds its educational approach within the matrix of Turkish culture and values, enriching students' cultural heritage and moral understanding. The approach aligns harmoniously with broader educational objectives to equip students with the practical competencies necessary for effective citizenship. This integration of Perennialist and Essentialist philosophies within the MoNE high school curriculum illustrates a clever fusion of tradition and modernity in education.

Viewed through the lens of an educator who has experienced both curricula, discrepancies may exist between the written curricula and their practical implementations.

For instance, the Ministry of National Education (MoNE) curriculum highlights competencies students should possess at the outset, yet these competencies should be explicitly reiterated later in the syllabus. This may leave their application during instruction primarily to the teacher's discretion.

In contrast, the International Baccalaureate Diploma Programme (IB DP) curriculum provides clear pedagogical guidelines aligned with the Learner Profile. This alignment and integration into the assessment procedure indicate a more meticulous attention to these facets within the curriculum's implementation.

However, the MoNE mathematics curriculum, while affording flexibility due to the absence of rigid boundaries in student assessment, could also pose limitations for students. This suggests the need for a more defined assessment structure within the MoNE curriculum to provide clear guidelines and expectations, thus maintaining a balance between flexibility and structure in student evaluation.

5.3. SUGGESTIONS FOR FURTHER RESEARCH

The present study explored the contrasts and parallels between the International Baccalaureate Diploma Programme (IBDP) and the Ministry of National Education (MoNE) curricula. For subsequent investigations, it would be beneficial to include additional documentation that elucidates the evaluation processes for both curricula. Additionally, a thorough examination of the implications of abolishing the mandatory attendance requirement within the MoNE program could be conducted. This could involve investigating the effects of the attendance procedure on the program and examining its implementation's ease and challenges.

A notable limitation of this study was its need for an evaluation concerning student progression and the efficacy of the curricula. Therefore, future research could involve the analysis of students' academic performances as a measure of curricular success.

In conclusion, the findings from this investigation can serve as a valuable resource for educators, potentially influencing their teaching processes and their adoption of varied pedagogical styles. The insights gleaned can contribute to a better understanding of how these different curricula impact teaching and learning, further informing practice in these educational settings.

5.4. CONCLUSION

This research presents a comparative analysis of the International Baccalaureate Diploma Programme (IB DP) mathematics curriculum and the Turkish National Ministry of National Education (MoNE) mathematics curriculum. It explores both curricula' underlying philosophies, content, teaching and learning processes, and assessment methods. The study serves a dual purpose: it may function as a guide for teachers implementing these curricula and as a model for curriculum developers.

For educators, the research findings can illuminate key points of attention during the teaching process, offering invaluable insights for understanding the philosophies underpinning both programs and facilitating more effective instruction. Moreover, the study provides a unique opportunity to enhance their pedagogical approach based on an in-depth understanding of the respective curricula.

The research also suggests potential enhancements to the curricula to better cater to student needs, thus shedding light on areas for future investigation. This analysis is

anticipated to inform future improvements in the curriculum design process and contribute to a richer, more nuanced understanding of the IB DP and MoNE mathematics curricula.

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APPENDIX A:

THEMES	SUB-THEMES	CODES	IB DP	MoNE
EDUCATIONAL PHILOSOPHY	Perennialism Essentialism Progressivism Reconstructionism	**Perennialism** • Culture and universal values • For humanity • To reach God • Socratic method **Essentialism** • Memorizing and Repetition • Cultural values served by the teacher & teacher centered • Protect cultural heritage • Transfer traditional skills to the future • To develop the community • culture, values and principles **Progressivism** • Teacher is guide for problem solving and inquiry • Learning is process • Active learning, activities and projects • Students' interests • Interdisciplinary **Reconstructionism** • International	**IB PAGE 9- PROGRESSIVISM AND RECONSTRUCTIVISM** International-mindedness is a complex and multi-faceted concept that refers to a **way of thinking, being and acting characterized by an openness to the world** and a recognition of our deep interconnectedness to others. One way of fostering **international-mindedness is to provide opportunities for inquiry into a range of local and global issues and ideas.** **IB PAGE 13- RECONSTRUCTIONISM** Concepts represent the vehicle for students' inquiry into issues and ideas of personal, **local and global significance**, providing the means by which they can explore the essence of mathematics. take action to apply and transfer skills to alternative situations, to other areas of	**MONE PAGE 5 - PERENNIALISM** Eğitim sistemimizin temel amacı **değerlerimiz ve yetkinliklerle bütünleşmiş bilgi, beceri ve davranışlara sahip bireyler yetiştirmekti**r. Bilgi, beceri ve davranışlar öğretim programlarıyla kazandırılmaya çalışılırken değerlerimiz ve yetkinlikler bu bilgi, beceri ve davranışların arasındaki bütünlüğü kuran bağlantı ve ufuk işlevi görmektedir. **Değerlerimiz toplumumuzun millî ve manevi kaynaklarından damıtılarak dünden bugüne ulaşmış ve yarınlarımıza aktaracağımız öz mirasımızdır.** Yetkinlikler ise bu mirasın hayata ve insanlık ailesine katılmasını ve katkı vermesini sağlayan eylemsel bütünlüklerimizdir. Bu yönüyle değerlerimiz ve

		mindedness • Local and global issues • Multicultural • World citizenship • Teacher acts like research leader	knowledge and to future developments in **their local and global communities appreciate the universality of mathematics and its multicultural, international and historical perspectives** **IB PAGE 14- PROGRESSIVISM** In the IB classroom, students should regularly learn mathematics by b**eing active participants in learning activities.** Teachers should therefore provide students with regular opportunities to learn through **mathematical inquiry, by making frequent use of strategies which stimulate students' critical thinking and problem-solving skills.**	yetkinlikler birbirinden ayrılmaz bir şekilde teori-pratik bütünlüğündeki asli parçamızı oluşturur. **MONE PAGE 7- PERENNIALISM** Sosyal ve vatandaşlıkla ilgili yetkinlikler: Bu yetkinlikler kişisel, kişilerarası ve kültürlerarası yetkinlikleri içermekte; bireylerin farklılaşan **toplum ve çalışma hayatına etkili ve yapıcı biçimde katılmalarına imkân tanıyacak; gerektiğinde çatışmaları çözecek özelliklerle donatılmasını sağlayan tüm davranış biçimlerini kapsar.** Vatandaşlıkla ilgili yetkinlik ise bireyleri, toplumsal ve siyasal kavram ve yapılara ilişkin bilgiye, demokratik ve aktif katılım kararlılığına dayalı olarak medeni hayata tam olarak katılmaları için donatmaktadır.

				MONE PAGE 5 - ESSENTIALISM Liseyi tamamlayan öğrencilerin, ilkokulda ve ortaokulda kazandıkları yetkinlikleri geliştirmek suretiyle**, millî ve manevi değerleri benimseyip hayat tarzına dönüştürmüş, üretken ve aktif vatandaşlar olarak yurdumuzun iktisadi, sosyal ve kültürel kalkınmasına katkıda bulunan**, "Türkiye Yeterlilikler Çerçevesi"nde ve ayrıca **disiplinlere özgü alanlarda ifadesini bulan temel düzey beceri ve yetkinlikleri kazanmış, ilgi ve yetenekleri doğrultusunda bir mesleğe, yükseköğretime ve hayata hazır** bireyler olmalarını sağlamak.

CONTENT	Course Information and Requirements Curriculum, syllabus and topic overview Applications and Real-world Connections History and Philosophy of Mathematics and different contexts Proof and Reasoning	• AA and AI course information • Mathematics course requirements • Course level information • Spiral program / curriculum • Format, outline and topics of the syllabus • Command terms and notations • Terms and concepts • Overall format of the topics • Symbols and notations • Concepts for topic1,2,3,4,5 • Information, definition, and importance of concepts • Applications of the content • Real life concepts, connections, and examples • History and philosophy of mathematics • Mathematics an music • Mathematics-economy relation • Mathematics-international mindedness relation	**PAGE 19** **Each topic has SL content followed by AHL content.** Teachers should ensure that they cover all SL content with SL students, and all SL and AHL content with HL students. **The topics are structured so that an informal introduction in the common content may be formalized in the SL** content and then extended further in the AHL content. For example the extension of the set of numbers for which something is defined could be integers in the common content, positive real numbers in the SL content and all real and complex numbers in the AHL content. **PAGE 20** **Each topic has three sections:** **Content:** The column on the left contains details of the sub-topics to be covered. **Guidance, clarification and syllabus links:** The column on the right contains more detailed information on specific sub-topics listed in the content column. This clarifies the content for the examination and highlights where sub-topics relate to other sub-topics within the syllabus. **Connections:** Each topic also contains a short section that provides	**PAGE 17** Programda 9, 10, 11, 12. sınıf ile 11 ve 12. sınıf temel düzeyleri yer almaktadır. Ortaöğretim (9-12. sınıflar) Matematik Dersi Öğretim Programı, 9 ve 10. sınıflar için tek bir içeriğe sahipken **11 ve 12. sınıflarda öğrencilerin ihtiyaç, hedef, kariyer planları gibi durumlarını dikkate alarak iki farklı seçenek sunmaktadır. 11 ve 12. sınıflarda yer alan Seçmeli Matematik, öğrencinin ilgi ve istekleri ile hedefledikleri yükseköğretim programları doğrultusunda Anadolu Liselerinde seçilen, Seçmeli Temel Matematik ise Mesleki ve Teknik, Güzel Sanatlar ve Spor Liseleri ile Anadolu Liselerinde matematik ağırlıklı bir programı tercih etmeyen öğrenciler (sözel-dil) tarafından seçilebilir**. Bu dersler, öğretim programının yapısı gereği 11 ve 12.

		• Mathematics-politics relation • Use of mathematics • Different solving methods • Proofs • Reasoning • Mathematical generalization • Different /multiple representation • Abstraction	suggestions for further discussion, including real-life examples and ideas for further investigation. Potential areas for connections include: • Other contexts: Real-life examples • Links to other subjects: Suggested connections to other subjects within the DP. Note that these are correct for the current (2019) published versions of the guides • Aim: Links to the aims of the course • International-mindedness: Suggestions for discussions • TOK: Suggestions for discussions • Links to TSM: Links to the teacher support materials (TSM) in the "in practice" section of the website • Link to specimen paper: Links to specific questions exemplifying how topics might be examined • Use of technology: Suggestions as to how technology can be used in the classroom to enhance understanding • Links to websites: Suggested websites for use in teaching or learning activities • Enrichment: Suggestions for further discussions that may reinforce understanding.	sınıflarda bir arada okutulamaz Programın içeriğinde **öğrenme alanları, alt öğrenme alanları ve konular** şeklinde sıralama yapılmıştır. Öğrenme alanlarına numara verilmemiş, öğrenme alanları büyük harf ile yazılmıştır. "Sayılar ve Cebir", "Geometri" ve "Veri, Sayma ve Olasılık" tan oluşan üç öğrenme alanı bulunmaktadır. Kazanımlar sınıf düzeyi, alt öğrenme alanı, konu ve kazanım numarası esas alınarak numaralandırılmış tır. Konuların yapısı şematik olarak sunulmuştur. **PAGE 43** 1. Öğrenciler **günlük hayatla ilişkili problem durumları ile** karşı karşıya bırakılmalı, onlara bunların üstesinden gelmenin yolları öğretilmelidir. 2. Tasarlanan **gerçek hayat problemleri,** öğrencilerde akıl yürütme ve karar vermelerini

				gerektirecek durumlar barındırmalıdır. 3. Problemler öğrencilerin kültürel çevrelerine uygun, ailelerini ve yakın çevrelerini içine alan gerçek hayat durumları ile ilişkilendirilmelidir. 4. **Derslerde, hayattaki olaylardan ve problemlerden başlanmalı,** öğrencilerin bazı konu ve kavramları öğrenmelerine dair bir ihtiyaç hissetmeleri sağlanmalıdır. Bu çerçevede ilgili kavramlar, problemin çözüm sürecinde irdelenmelidir.

TEACHING AND LEARNING	Teaching and Learning Approaches Technology in Teaching and Learning Learner Profile, Student Responsibilities and Skills School and Teacher Responsibilities Teacher Support Materials	• Active learning • Concept learning • Inquiry and investigation • Learning with concepts • Interdisciplinary • ATTL • Modelling • Discussion • Transfer skills • Project-based learning • Data and statistical tools • Use of DGS, graphing and interpret graphing • Use of technology- interpreting the results • Different types of technology • Learner profile • Learner profile- IA, ATTL and CP connection • Thinking • Knowledge, skills, behaviors • Reflection • Students' awareness about themselves • Students' competencies, interests and responsibility • Students' writing and Academic honesty	**IB MISSION STATEMENT** These programmes encourage students across the world to **become active,** compassionate and lifelong learners who understand that other people, with their differences, can also be right. **PAGE 4** encourage students to develop an explicit variety of skills that will equip them to **continue to be actively engaged in learning** after they leave school, and to help them not only obtain university admission through better grades but also prepare for success during tertiary education and beyond **PAGE 14** In the IB classroom, students should regularly learn mathematics by being **active participants** in learning activities. **PAGE 13** In DP mathematics courses, c**onceptual understandings** are key to promoting deep learning. **The course identifies twelve fundamental concepts which relate with varying emphasis to each of the five topics**. Teachers may identify and develop additional concepts to meet local circumstances and national or state	**PAGE 7** Sosyal ve vatandaşlıkla ilgili yetkinlikler: Bu yetkinlikler kişisel, kişilerarası ve kültürlerarası yetkinlikleri içermekte; bireylerin farklılaşan toplum ve çalışma hayatına etkili ve yapıcı biçimde katılmalarına imkân tanıyacak; gerektiğinde çatışmaları çözecek özelliklerle donatılmasını sağlayan tüm davranış biçimlerini kapsar. Vatandaşlıkla ilgili yetkinlik ise bireyleri, toplumsal ve siyasal kavram ve yapılara ilişkin bilgiye, demokratik ve **aktif katılım** kararlılığına dayalı olarak medeni hayata tam olarak katılmaları için donatmaktadır. **PAGE 8** Çok odaklı ölçme değerlendirme esastır. Ölçme ve değerlendirme uygulamaları **öğretmen ve öğrencilerin aktif katılımıyla** gerçekleştirilir. **PAGE 32** a) y=sinx ve

		• Critical thinking • Self-management • Problem solving • Collaboration • Communication / Mathematical communication • Role of coordinators • Schools' role and responsibilities • Teachers' role, qualifications and responsibility • Students who have special needs • Formula booklet • Formulae, rules • Purchasing resources • Related people of the documents • Curriculum additional documents	curriculum requirements. **Teachers can use these concepts to develop connections throughout the curriculum**. E**ach topic in this guide begins by stating the essential understandings of the topic and highlighting relevant concepts fundamental to the topic.** This is followed by suggested conceptual understandings relevant to the content within the topic, although this list is not intended to be prescriptive or exhaustive. **Concepts** promote the development of a broad, balanced, conceptual and connected curriculum. They represent big ideas that are relevant and facilitate connections within topics, across topics and also to other subjects within the DP. **The twelve concepts identified below support conceptual understanding, can inform units of work and can help to organize teaching and learning. Explanations of each of these concepts in a mathematical context have also been provided.** **PAGE 13** **Modelling:** This concept refers to the way in	y=cosx fonksiyonları dışındaki fonksiyonların grafik **çizimlerinde sadece bilgi ve iletişim teknolojileri kullanılır.** **PAGE 6** Matematiksel yetkinlik, düşünme (mantıksal ve uzamsal düşünme) ve s**unmanın (formüller, modeller, kurgular, grafikler ve tablolar**) matematiksel modlarını farklı derecelerde kullanma beceri ve isteğini içermektedir. **PAGE 37** 12.1.3.2. Üstel ve logaritmik fonksiyonları **gerçek hayat durumlarını modellemede** kullanır. **PAGE 39** 12.5.2.1. Türev kavramını açıklayarak işlemler yapar. a) Anlık değişim oranı **fizik ve geometri modellerinden** yararlanılarak açıklanır. **PAGE 11** 1739 sayılı Millî Eğitim Temel Kanunu'nun 2. maddesinde ifade

			which mathematics can be used to represent the real world. **Relationships:** This concept refers to the connection between quantities, properties or concepts; **these connections may be expressed as models, rules or statements**. Relationships provide opportunities for students to explore patterns in the world around them. **PAGE 14-15** **Mathematical modelling** is an important technique used in problem solving, to make sense of the real world. It is often used to help us better understand a situation, to check the effects of change or to inform decision-making. **Engaging students in the mathematical modelling process provides them with such opportunities**. It is one of the most useful mathematical skills that students will need to be successful in many non-mathematical as well as mathematical courses and careers. **PAGE 19** As teachers tie together the unifying themes of **mathematical inquiry, mathematical modelling and the use of technology,** they should begin by providing substantial guidance and then	edilen Türk Millî Eğitiminin Genel Amaçları ile Türk Millî Eğitiminin Temel İlkeleri esas alınarak hazırlanan Matematik Dersi Öğretim Programıyla öğrencilerin; 1. Problemlere farklı açılardan bakarak **problem çözme becerilerini** geliştirmeleri, 2. **Matematiksel düşünme** ve uygulama becerileri kazanmaları, 3. Matematiği doğru, etkili ve faydalı bir şekilde kullanmaları, 4. Matematiğe ve matematik öğrenimine değer vermeleri, 5. **Matematiğin tarihsel gelişim sürecini**, matematiğin gelişimine katkı sağlayan bilim insanlarını ve onların çalışmalarını tanımaları, 6. Hayatta karşılaştıkları bir sorunun onlar için problem olup olmadığına dair bakış açısı geliştirip belli bir bilgi düzeyine ulaşmaları amaçlanmıştır. **PAGE 43**

			gradually encourage students to become more independent as **inquirers and thinkers**. DP students should learn to become strong communicators through the language of mathematics. Teachers should create a learning environment in which students are comfortable as risk takers and inquiry, conceptual understanding, collaboration and use of technology feature prominently. **PAGE 20** it is expected that **30 hours will be spent on developing inquiry, modelling and investigation skills.** **PAGE 23** **Problem solving**: Recall, select and use their knowledge of **mathematical skills, results and models** in both abstract and real-world contexts to solve problems. **PAGE 28** Essential understandings: Number and algebra allow us to **represent patterns, show equivalencies and make generalizations which enable us to model real-world situations**. Algebra is an abstraction of numerical concepts and employs variables which allow us to solve mathematical	Öğrencilerin **problem çözme becerilerinin** geliştirilmesi, programın temel hedeflerindendir. Arzulanan bu amaçlara ulaşılabilmesi için aşağıdaki hususlar dikkate alınmalıdır: **PAGE 8** Eğitimde çeşitlilik; birey, eğitim düzeyi, ders içeriği, sosyal ortam, okul imkânları vb. iç ve dış dinamiklerden ciddi şekilde etkilendiği için, ölçme ve değerlendirme uygulamalarının etkililiğini sağlamada öncelik **öğretim programlarından değil öğretmen ve eğitim uygulayıcılarından beklenir. Bu noktada özgünlük ve yaratıcılık öğretmenlerden temel beklentidir.** **PAGE 9** Programların amaçlarını ve kazanımlarını gerçekleştirme sürecinde gerekli uyarlamaların **öğretmen tarafından** yapılması beklenir **PAGE 12** Öğretim materyalleri

			problems. **PAGE 28** Content-specific conceptual understandings: • **Modelling real-life situations** with the structure of arithmetic and geometric sequences and series allows for prediction, analysis and interpretation. **PAGE 37** Concept of a function, domain, range and graph. Function notation, for example f (x), v(t), C(n). **The concept of a function as a mathematical model**. **PAGE 62** **Use of technology: Spreadsheets, dynamic graphing** software and **GDC** should be used to explore ideas of limits, numerically and graphically. Hypotheses can be formed and then tested using technology. **PAGE 74** Paper 2 Students **must have access to a graphic display calculator (GDC) at all time**s. However, not all questions will necessarily require the use of the GDC. Regulations covering the types of GDC allowed are provided in Diploma Programme Assessment procedures. **PAGE 84**	hazırlanırken **zümre öğretmenleri ve diğer disiplinlerin öğretmenleriyle iş birliği yapılmalıdır.**

			encourage students, where appropriate, to discover, use and appreciate the **power of technology** as a mathematical tool **PAGE 8** The course allows the **use of technology,** as fluency in relevant mathematical software and hand-held technology is important regardless of choice of course. **PAGE 10** However, Mathematics: analysis and approaches has a strong emphasis on the ability to construct, communicate and justify correct mathematical arguments. Students may also draw on their CAS experiences to enrich their involvement in mathematics both within and outside the classroom, and mathematics **teachers can assist students** in making links between their subjects and students' CAS experiences where appropriate. **PAGE 10** **Teachers should be informed by their assessment of students' prior learning** to help plan their teaching so that topics mentioned that are unfamiliar to their students can be incorporated.	

			PAGE 4 The IB does not prescribe which style(s) of referencing or in-text citation should be used by candidates; this is left to the discretion of appropriate faculty/staff in the **candidate's school.** **PAGE 71** The **school is required to ensure that that equal access arrangements and reasonable adjustments are provided to candidates** with learning support requirements that are in line with the IB documents	

ASSESSMENT	Assessment Information, Outlines and Marking Teaching and Assessment Flexibility Assessment types (Internal, external, formative, summative) Exam details and question types	• Assessment policy, criteria, and procedure • Assessment procedure for teachers and students • Assessment tips • SL and HL assessment outline • Marking criteria and markschemes • Flexible upper limit • Prior learning / teachers' flexibility • Teachers' flexibility • Upper limit • Flexibility of the school • Different Assessment techniques • Enrichment • Formative assessment • Summative assessment • Norm-related • Criterion-related • Process evaluation • Internal assessment • External assessment • Details of paper1,2,3 • Calculator regulation and Formula booklet	**PAGE 19** The content of all five topics at the appropriate level must be taught, **however not necessarily in the order in which they appear in the guide**. (FLEXIBILITY) **PAGE 70** Assessment criteria are used when the assessment task is **open-ended**. An assessment objective describes what students should be able to do, and assessment criteria describe how well they should be able to do it. Using assessment criteria **allows discrimination between different answers and encourages a variety of responses**.Each criterion comprises a set of **hierarchically-ordered level descriptors.** Each level descriptor is **worth one or more marks**. Each criterion is applied independently using a best-fit model. **The maximum marks for each criterion may differ according to the criterion's importance**. The marks awarded for each criterion are addedtogether to give the total mark for the piece of work. **PAGE 71** Analytic markschemes are prepared for those examination questions **that expect a particular**	**PAGE 8** Öğretim programı, ölçme sürecinde kullanılabilecek ölçme araç ve yöntemleri açısından uygulayıcılara **kesin sınırlar çizmez, sadece yol gösterir.** Ancak tercih edilen ölçme ve değerlendirme araç ve yönteminde, gereken teknik ve akademik standartlara uyulmalıdır Eğitimde ölçme ve değerlendirme uygulamaları eğitimin ayrılmaz bir parçasıdır ve eğitim **süreci boyunca yapılır.** Ölçme sonuçları tek başına değil izlenen süreçlerle birlikte bütünlük içinde ele alınır. Eğitim sadece "bilme (düşünce)" için değil, "hissetme (duygu)" ve "yapma (eylem)" için de verilir; dolayısıyla **sadece bilişsel ölçümler yeterli kabul edilemez.** **Çok odaklı ölçme değerlendirme esastır.** Ölçme ve değerlendirme uygulamaları öğretmen ve öğrencilerin aktif

		• Short response questions • Extended response questions • Reasoning emphasized questions • From easy to complex questions • Different representations of questions	**kind of response and/or a given final answer from students. They give detailed instructions to examiners on how to break down the total mark for each question for different parts of the response**. **PAGE 75** SECTION A • A **small number of steps** are needed to solve each question. • Questions may be presented in the form of words, symbols, diagrams or tables, or combinations of these. SECTION B • Questions require **extended responses** involving sustained reasoning. • Individual questions will develop a single theme. • Questions may be presented in the form of words, symbols, diagrams or tables, or combinations of these. • Normally, each question reflects an incline of difficulty, **from relatively easy tasks at the start of a question to relatively difficult tasks at the end of a question**. The emphasis is on sustained reasoning. **PAGE 76** This section consists of compulsory **short-response questions** based on the whole syllabus. It is worth approximately 40 marks	katılımıyla gerçekleştirilir. Bireylerin ölçme ve değerlendirmeye konu olan ilgi, tutum, değer ve başarı gibi özellikleri zamanla değişebilir. Bu sebeple söz konusu özellikler**i tek bir zamanda ölçmek yerine süreç içindeki değişimleri dikkate alan ölçümler kullanmak esastı**r.

			This section consists of a small number of compulsory **extended-response questions** based on the whole syllabus. **PAGE 76** Papers 1, 2 and 3 These papers are externally set and **externally marked**. Together, they contribute 80% of the final mark for the course. These papers are designed to allow students to demonstrate what they know and what they can do. **PAGE 77** **Knowledge of all topics is required for this paper**. However, not all topics are necessarily assessed in every examination session **PAGE 80** **Internal assessment** is an integral part of the course and is compulsory for both SL and HL students. It enables students to demonstrate the application of their skills and knowledge and to pursue their personal interests without the time limitations and other constraints that are associated with written examinations. **PAGE 82** For internal assessment, a **number of assessment criteria have been identified**. Each assessment	

			criterion has level descriptors describing specific achievement levels, together with an appropriate range of marks. The level descriptors concentrate on positive achievement, although for the lower levels failure to achieve may be included in the description. Teachers must judge the internally assessed work at SL and at HL against the criteria using the level descriptors. Criterion A Presentation Criterion B Mathematical communication Criterion C Personal engagement Criterion D Reflection Criterion E Use of mathematics	