Netherlands

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Introduction

Overview of Education System

The Dutch education system combines a centralized framework and policies with decentralized administration and school management, thus reflecting a balance between national direction and local adaptation. This balance is based on the principle of "freedom of education," which is guaranteed by Article 23 of the Dutch Constitution.[1] This principle affords individuals the right to establish schools, determine their own principles, and organize instruction, highlighting the decentralized aspect of the system.

The centralized aspect of the Dutch education system is embodied by the Dutch Ministry of Education, Culture and Science. The Ministry carries the overall responsibility of the education system and shapes the strategic direction of education in the Netherlands.[2] It establishes education policies such as curriculum frameworks, quality standards, and assessment methods that guide various education levels and institutions.[3] School boards, comprising of representatives of the municipality, assume an important role in overseeing the strategic direction and management of schools. The school boards are entrusted with autonomous decision-making responsibilities concerning resource allocation, staffing, school policies, and the implementation of the curriculum.[4]

To maintain the expected quality of education, the Dutch Inspectorate of Education conducts periodic school visits once every 4 years.[5] If a school falls short of established standards, the governing board must take corrective measures to enhance the quality of education. Ongoing supervision and interim assessments may be conducted to monitor progress and assess improvements. While the Inspectorate can apply sanctions to underperforming schools, the final decision concerning school closure rests with the Minister of Education, Culture and Science. The findings from school inspection visits are reported to the respective schools, the government, and the public.

In the Netherlands, education is compulsory for children starting at age 5.[6] Compulsory education ends either when children receive their basic qualification or when they reach the age of 18. Primary education, equivalent to International Standard Classification of Education (ISCED) Level 1, prepares students for further education and provides students with the

knowledge, skills, and values needed to be an active member of society. Primary education spans 8 years, from Group 1 to Group 8, and introduces students to fundamental skills and knowledge in subjects such as mathematics, language, and citizenship. The Dutch education system encourages a diverse education landscape where parents have the freedom to choose schools that align with their preferences. Consequently, various types of primary schools exist, including public, private, and nondenominational private schools.[7] Public schools are open to all, while private schools often follow religious or ideological convictions. Nondenominational private schools adopt pedagogical approaches such as Montessori or Dalton.

In the final year of primary education (Group 8), students take an attainment test that can be used to advise students on which secondary school track fits the level of the student. Upon completing primary school, students progress to secondary school (ISCED 2 and 3), where a range of educational tracks is offered. Each track aims to ensure that students receive education tailored to their strengths and provides various pathways for further education or entering the workforce. These tracks include the following:[8,9]

- prevocational secondary education (VMBO)—a 4-year program that offers both theoretical and practical courses. This track offers four programs: basic vocational (BL), middle-management vocational (KL), combined vocational and theoretical (GL), and theoretical (TL). After completing VMBO, students may pursue secondary vocational education (MBO), which is an education program that offers a more specialized curriculum aligned with specific industries and professions. Students can also pursue senior general secondary education (HAVO) if they have completed the combined or theoretical program.
- senior general secondary education (HAVO)—a 5-year program that offers a more extensive curriculum than prevocational secondary education and focuses on both theoretical and practical courses. Upon completion, students can choose to pursue higher education at a research university of applied sciences (HBO) or continue with preuniversity secondary education (VWO).
- preuniversity secondary education (VWO)—a 6-year educational track that emphasizes theoretical knowledge. After completing the preuniversity secondary education track, students can pursue higher education at research universities.

It is important to note that practical training (PRO) is offered to students who are not expected to complete their secondary education with a diploma. These programs directly prepare students for the labor market and are available until the age of 18.

Depending on the level of completed secondary education, students can further their academic pursuits in tertiary education, commonly known as higher education. Tertiary education is offered by both universities and HBO institutions, each providing a diverse range of academic and professional programs. Dutch universities offer more academically oriented programs, while HBO institutions offer more practical and profession-oriented programs. Tertiary education offers bachelor's, master's, and doctoral degree programs, allowing students to specialize in various fields.

Use and Impact of TIMSS

The Dutch government aims to be among the world's top knowledge economies, which has driven participation in large-scale international assessment studies, including TIMSS, PIRLS, and the Programme for International Student Assessment (PISA).

After initially participating in the International Association for the Evaluation of Educational Achievement (IEA)'s First and Second International Mathematics Studies and First and Second International Science Studies, the Netherlands has actively participated in all TIMSS studies since 1995, assessing students at various grade levels. In 1995, the Netherlands assessed students in Grades 3 and 4, Grades 7 and 8, and the final year of secondary education. In 1999, the Netherlands participated with students in Grade 8. In 2003, both Grade 4 and Grade 8 students were assessed. In subsequent study cycles (2007, 2011, 2015, 2019, and 2023), the Netherlands has participated exclusively with students in Grade 4. Additionally, the Netherlands participated in TIMSS Advanced 2008, which assessed students in Grade 12.

TIMSS results have been used by policymakers to implement changes in education policy.[10] Notably, a small decline in reading (PIRLS) and mathematics (TIMSS) achievement from 1995 to 2007 led to a policy shift toward emphasizing reading and numeracy in primary and lower secondary education. This shift resulted in the introduction of reference levels for these subjects in 2010. (See the section The The Mathematics Curriculum in Primary and Lower Secondary Grades for more information about reference levels.)

Furthermore, TIMSS and PIRLS results from 2011 indicated relatively low percentages of Dutch students reaching advanced benchmarks compared to other high-achieving countries. These findings prompted discussions on developing talent in education and initiatives aimed at nurturing high-achieving students.

The results of TIMSS 2015 and TIMSS 2019 did not directly lead to changes in education policy. However, the curriculum for primary and lower secondary education is currently under revision. The revised curriculum aims to create a better alignment between primary, secondary, and tertiary education, enhancing subject coherence while reducing program overload. The revised curriculum is intended to provide schools and teachers with more flexibility in content alignment with the education needs of the students.[11]

The Mathematics Curriculum in Primary and Lower Secondary Grades

The current mathematics curriculum for primary school comprises 11 core objectives divided into three categories.[12,13] These objectives, outlined by the Ministry of Education, Culture and Science, describe specific learning goals of the expected knowledge and skills that students should have acquired by the end of primary education. The core objectives cover a wide range of mathematical topics and concepts and aim to provide foundational mathematical skills and knowledge to students to navigate mathematical challenges and everyday situations. The core objectives are shown in Exhibit 1.

Exhibit 1: Mathematics Core Objectives for Primary Education in the Netherlands

Domain	Core Objectives
Mathematical Understanding	• use mathematical language • solve practical and formal mathematical problems and clearly demonstrate the process of finding a solution • identify different approaches for solving mathematical problems and learn to assess the reasonableness of solutions
Numbers and Operations	• understand the general structure and interrelationship of quantities, whole numbers, decimal numbers, fractions, percentages, and proportions, and use these to do arithmetic in practical situations • quickly carry out basic arithmetic calculations mentally, using whole numbers through 100, and learn to add and subtract up to 20 and the multiplication tables by heart • count and calculate by estimation • add, subtract, multiply, and divide by taking advantage of number properties • add, subtract, multiply, and divide on paper based on one or more standard procedures • use a calculator with insight
Measuring and Geometry	• solve simple geometric problems • measure and calculate using units of time, money, length, circumference, area, volume, weight, speed, and temperature

The core objectives are closely related to the reference levels. In 2010, reference levels, or benchmarks for language (Dutch and English) and numeracy, were introduced to help raise student achievement in primary and secondary education.[14,15] The levels provide a more detailed description of students' expected achievement levels at different stages of their education. The F level (Fundamental) describes basic skills and knowledge, while the S level (Advanced) encompasses more advanced and complex skills. By the end of primary education, at least 85% of students are expected to have reached reference level 1F; after VMBO, HAVO, or VWO, they are expected to have reached reference level 2F, 3F, or 4F. Furthermore, it is a goal to have at least 65% of students reach reference level 1S.

The core objectives for mathematics by the end of the lower secondary grades (Grade 8) comprise nine goals that students are expected to achieve.[16] These objectives cover various mathematical concepts and skills and provide the foundation for students' mathematical proficiency as they progress in their education. The core objectives are outlined in Exhibit 2.

Exhibit 2: Mathematics Core Objectives for Lower Secondary Education in the Netherlands

Core Objectives
• use appropriate mathematical language to organize mathematical thinking, explain things to others, and understand explanations in the context of mathematics
• recognize and use mathematics to solve problems in practical situations, both individually and in collaboration with others
• establish a mathematical argument and distinguish it from opinion, learning to give and receive mathematical criticism and to respect other ways of thinking
• recognize the structure and coherence of the systems of positive and negative numbers, decimal numbers, fractions, percentages, and proportions, and learn to work with these systems meaningfully in practical situations
• make exact calculations, provide estimates, and demonstrate an understanding of accuracy, order of magnitude, and margin of error appropriate to a given situation
• make measurements, recognize the structure and coherence of the metric system, and calculate with measurements in common applications
• use informal notations, schematic representations, tables, diagrams, and formulas to understand connections between quantities and variables
• work with two- and three-dimensional shapes and solids, make and interpret representations of these objects, and calculate and reason using their properties
• learn to describe, order, and visualize data systematically, and to judge data, representations, and conclusions critically

In secondary education, there are four reference levels that range from the fundamental levels 2F and 3F to the advanced levels 2S and 3S.[17] Depending on the students' educational track, different reference levels apply. For prevocational secondary education, it is expected that students reach 2F, while senior general secondary education and preuniversity secondary education students are expected to achieve reference level 3F.

The Science Curriculum in Primary and Lower Secondary Grades

In primary education, science is taught within the content area Personal and World Orientation. The curriculum in this area is organized to teach students to orientate themselves, how people relate to each other, how they solve problems, and how they give meaning to their existence.[18] The educational content of Personal and World Orientation is presented as a coherent whole, and content from other learning areas is applied as much as possible. The seven core objectives for the science subcategory Nature and Technology are outlined in Exhibit 3.[19,20]

Exhibit 3: Science Core Objectives for Primary Education in the Netherlands

Core Objectives
• distinguish, name, and describe the roles and functions of common plants and animals
• describe the structures of plants, animals, and humans, and the form and function of their parts
• research material and physical phenomena, including light, sound, electricity, power, magnetism, and temperature
• describe weather and climate in terms of temperature, precipitation, and wind
• find connections between form, material composition, and function of common products
• design, implement, and evaluate solutions to technical problems
• describe the positions and motions of the Earth-Sun system that cause the seasons as well as night and day

In secondary education, science is taught within the content area Man and Nature.[21] The eight core objectives as outlined in Exhibit 4 cover a broad range of content and are focused on natural science, technology, and health-related topics. They provide a general overview of skills and knowledge, including having an investigative attitude toward nature, connecting theories and models with practical work, and promoting sustainability.

Exhibit 4: Science Core Objectives for Lower Secondary Education in the Netherlands

Domain	Core Objectives
Asking Questions	• transform questions arising from topics pertaining to the sciences, technology, and human health and welfare into research questions; carry out an investigation on a scientific topic and present the results • acquire knowledge about and insight into the nature of living and nonliving things, as well as their relationship to the environment, through experimentation
Approach of Key Concepts	• acquire knowledge about and insight into key concepts of living and nonliving things and connect these key concepts with situations from everyday life • describe how people, animals, and plants are related to each other and the environment, and how technological and scientific applications can have permanent positive or negative influences on these living systems
Specific Topics and Skills	• work with theories and models by investigating chemical and physical science phenomena, such as electricity, sound, light, movement, energy, and matter • acquire knowledge about technical products and systems through investigation, estimate the value of this knowledge, and design and construct a technical product • understand the essential structures and functions of human body systems, establish connections between these systems and the promotion of physical and psychological health, and take responsibility for one's own health • care for oneself and others, one's environment, one's safety, and the safety of others

Teacher Professional Development Requirements and Programs

Professional Development Requirements

In the Netherlands, explicit professional development requirements that are governed by law do not exist. Specific professional development requirements may vary depending on the school, region, and teacher's level of experience. However, as the quality of education is closely tied to the caliber of teaching, the government aims to enhance teachers' professional development.[22]

In the Netherlands, the collective labor agreement (CAO) outlines the terms and conditions of employment across various sectors, including education. According to the CAO, teachers in primary education are entitled to 2 hours per week of individual professional development when employed full-time. For teachers in secondary education, this amounts to 83 hours per year. These allocated professional development hours aim to assist teachers in enhancing their skills and knowledge to provide better education to students.[23]

Report on the State of Education 2023, a Dutch report that provides an overview and assessment of the state of education in the Netherlands, underscores the priority of teacher professional development, even amid the current teacher shortage.[24] Currently, teachers often abstain from participating, citing concerns such as the significant time commitment, the appropriateness of the offerings, and insufficient encouragement from their employers. To address these challenges, the report emphasized the need for school boards to prioritize and facilitate well-considered professional development policies that align with teachers' learning needs.

Thus, both the *Report on the State of Education 2023* and the CAO agreements for education underscore the importance of ongoing professional development for primary and secondary school teachers in the Netherlands. Regular engagement in professional development activities is encouraged.

Ongoing Professional Development Programs

A variety of courses and professional development programs are designed to enhance teachers' didactic skills and keep educators updated with the latest education practices in the Netherlands. Teachers can join professional learning groups to exchange best practices and collectively address challenges in teaching. Additionally, various organizations and institutions offer workshops, seminars, and online courses on innovative teaching methods, curriculum development, and assessment strategies. Furthermore, teachers are encouraged to join in-service training opportunities that schools often provide or to attend both national and international conferences focusing on subject-specific education trends, research, and teaching approaches. All of the professional development programs aim to improve the quality of education, foster innovative teaching approaches, and ensure teachers are equipped with the skills and knowledge needed to deliver high-quality education that in turn benefits their students' learning experience.

Monitoring Student Progress in Mathematics and Science

While schools are obliged to track student progress, they are autonomous in deciding when and how to assess student progress.[25] Students receive grades based on their performance in various assessments such as tests, assignments, and projects. The grades are on a scale of 1 to 10, and partial grades can also be awarded. Report cards are issued periodically, providing both students and teachers with a comprehensive overview of students' academic progress.

In the last year of primary education, a mandatory attainment test is administered to all students.[26] The attainment test is designed to evaluate student performance across the obligatory domains of mathematics and reading literacy alongside elective domains such as geography and history. Before participating in the attainment test, students receive provisional advice from their school, guiding them toward the most appropriate secondary education trajectory. Should the attainment test results indicate the potential for a higher educational track, it becomes imperative for schools to align their initial recommendations with the outcomes of

the attainment test. However, exceptions may be made under specific circumstances where it is not deemed advantageous for the students to revise their initial recommendations. Schools are afforded the flexibility to select from various attainment tests provided by various national institutions (e.g., Cito, IEP, ROUTE 8). The quality of the attainment test is guaranteed by the *College voor Toetsen en Examens* (College for Tests and Exams).

Following primary education, students progress to secondary education, where they follow an educational track best suited for their skills and capabilities. At the end of each of these educational tracks, students must pass a final examination to finish secondary school. This examination combines the outcomes of both the school-level examinations and the central examination. Schools have a considerable degree of autonomy in shaping the content and focus of their school-level examinations. In contrast, as the name indicates, the central exam denotes a standardized, nationwide assessment applicable to all students within the same educational track. For each education level and every subject herein, a distinct central exam has been designed. For the majority of subjects, the final grade is determined by computing the average of scores achieved in both the school-level examination and the central examination.[27]

Special Initiatives in Mathematics and Science Education

In the Netherlands, multiple initiatives drive the promotion of mathematics and science education, aiming to inspire and encourage students to excel in and pursue careers in fields related to mathematics, science, and technology.

Platform Bèta Techniek is a foundation that implements national policy in the field of education with an emphasis on science and technology.[28] The platform aims to promote general interest and encourages participation in science and technology–related education. *Platform Bèta Techniek* operates under the name *Platform Talent voor Technologie* (Platform Talent of Technology) and through its brands *Katapult* and Jet-Net. By making technology visible for young people and promoting cooperation between education, government, and businesses, the platform strives to foster interest in technology and promote enrollment in mathematics-, science-, and technology-related studies.

Another initiative is Junior Technovium.[29] Students ages 10 to 15 are encouraged to explore their talents and passion for technology and science. Through specifically designed programs, Junior Technovium aims to instill enthusiasm and confidence in working with technology, fostering skills in experimenting, prototype design, and problem-solving through programming. The initiative also organizes science and technology events, such as the First Lego League, and contributes to the integration of computational thinking in schools.

The National Talent Centre of the Netherlands (NTCN) serves as a vital hub connecting, facilitating, and inspiring talent and creativity in children.[30] Recognizing talent development as a dynamic process, the NTCN strives to create an optimal coordination environment. Functioning as a resourceful platform, the center facilitates the exchange of information among schools, teachers, parents, students, experts, and policymakers involved in talent development initiatives.

Moreover, the NTCN's website provides access to a variety of learning materials tailored for primary, secondary, and tertiary education. This emphasis on knowledge sharing and accessible educational resources underscores the center's commitment to fostering talent in mathematics, science, and technology.

Suggested Reading

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