



entuzjaści edukacji

France

correlation among subjects,
experiments as the basis
of science education

England

problem-based coverage
of content, research
methods as the basis
for science education

Finland

development of social
competence and responsibility
for one's own education

Estonia

interdisciplinary teaching
(subject blocks), development
of social competences

Poland

emphasis on the development
of skills, research methods
present in science education

Czech Republic

addressing pupils' misconceptions
in science education

Science education in Poland –improving what is good

A study of the Science Section of the Educational
Research Institute *Core curriculum for science
subjects in selected countries*



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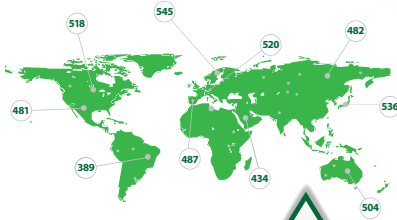
What is the rationale behind the comparison of core curricula for science subjects?

The Educational Research Institute (Instytut Badań Edukacyjnych, IBE) compared the core curricula in the scope of science subjects in force in five European countries with the Polish Core Curriculum.

In the Polish Core Curriculum¹, emphasis is placed on the formation and development of the skills of scientific reasoning and applying the scientific method. A steady improvement has been observed of the results of students from Polish schools in the international PISA study in the part concerning reasoning in natural sciences. However, the results of the IBE's research indicate the possibility of improving both the teacher's work and the core curriculum binding in Polish schools. It was determined that comparing it with foreign documents, in force in the countries whose students have for years obtained excellent results in applying the scientific method when solving problems, may be one of the routes leading to further improvement of the quality of scientific education in Poland.

¹ Regulation of the Minister of National Education and Sport of 26 February 2002 on the core curriculum for preschool and general education in specific types of schools of 23 December 2008 and – again – of 27 August 2012, Journal of Laws of 30 August 2012, item 977.

PISA



Developments in Polish Education

May
new formula of the upper secondary school exam (the same year) • **2015**

April
new lower secondary school exam • **2012**

December
diagnosis of lower secondary school students' competences, IBE
September
exemplar set of exam questions (involvement of IBE) • **2011**

September
new lower secondary school exam guidebook (involvement of IBE)

May
implementation of compulsory upper secondary school exam in mathematics • **2010**

September
new core curriculum begins to be implemented in schools, the new Pedagogical Supervision System is in force

March
the PISA study • **2009**

preparation of a new core curriculum, preparation of the assumptions for a new Pedagogical Supervision System • **2008**

508

Poland at the level of the OECD average

2009

498

Poland at the level of the OECD average

2006

497

Poland at the level of the OECD average

2003

subsequent years of students who studied in the lower secondary school according to the old core curriculum

479

Poland below the OECD average

2000

students of secondary school and those who completed the 8-grade primary school

Reasoning in natural science

2012

the first year which of studies in the lower secondary school according to the new core curriculum of general education

526

Poland above the OECD average

About the study

Aim of the study

The aim of the comparative analysis was to examine whether the formation and development of scientific reasoning skills and applying the scientific method occupies a similar place and is assigned the same high weight in the Polish Core Curriculum and the core curricula in force in the European countries selected for the study.

The comparison was also aimed at identifying of the similarities and differences between the documents which might form an inspiration for perfecting the Polish document.

Table 1. Characteristics of countries selected for comparison of core curricula for science subjects with the Polish Core Curriculum.

No.	Country	Result in the science part at the study PISA 2006 (points)	Value of GDP/capita in 2010 (PPS) ²	Geopolitical location
1.	Czech Republic	513	80	a post-socialist country, undergoing intense economic growth
2.	Estonia	531	63	a post-socialist country, undergoing intense economic growth
3.	Finland	563	114	the country which was the first to free itself from the influence of the socialist system, oriented on development of the education system and growth of the education level of citizens
4.	France	495 ³	109	a Western country with a high wealth level
5.	United Kingdom ⁴	515	112	a Western country with a high wealth level

² PPS – Purchasing Power Standard – an artificial common currency, enabling comparison of the value of GDP in countries with binding different currencies and levels of prices of the same products.

³ The total result comparative with Poland (495 points), but clearly different results in subscales of skills. In the scope of recognising scientific issues, France scored 499 points, Poland – 483 points, in the scope of interpretation of and acting on scientific results and evidence, France scored 511 points, Poland – 494 points.

⁴ Data concerning the United Kingdom were taken into account (there are no data concerning England in Eurostat, similarly the results in PISA were provided for the United Kingdom as a whole).

Selection of countries

Documents in force in the Czech Republic, Estonia, Finland, France and England⁵ were selected for analysis. The selection of the countries was guided, among other things, by students' skill level, described by students' results in reasoning in natural sciences in the PISA study in 2006. Countries were selected with average results higher than Polish (Finland, Estonia, England, the Czech Republic) and average results similar to the Polish ones, but significantly higher in the scope of recognising scientific issues and in the scope of interpretation and acting on scientific results and evidence (France) (see Table 1).

Selection of the educational stage

The focus of the study was on level ISCED2, that is the Polish lower secondary school. It resulted, among others factors, from the age of students diagnosed in the PISA study. Moreover, the important position of the lower secondary school in Poland, resulting from the fact that implementation of the new core curriculum started in September 2009, precisely at the level of the first grade of lower secondary school, was taken into account.

In the case of Poland, the comparison incorporated the part of the core curriculum for science subjects (biology, chemistry, physics, geography), valid at the stage of lower secondary school (3 years) and in the first grade of upper secondary school, which constitutes a full teaching cycle. This is the last stage, at which teaching science is common and obligatory, thus it is essential for the development of scientific knowledge and skills of young citizens.

The selection of fragments of core curricula binding at analogous educational stages in the chosen countries was not always easy. The education systems of the countries sometimes have different structures than in the Polish system, and thus the division into primary (ISCED 1), lower secondary (ISCED 2) and upper secondary (ISCED 3) schools does not always overlap with the Polish system.

Selection of school subjects

The parts of the core curricula were compared which regulated the teaching corresponding in scope to the four science subjects taught in Poland: biology, chemistry, physics and geography. In some of the studied countries, the science subjects taught are called differently than

⁵ It should be emphasised that not the whole country is concerned (the United Kingdom of Great Britain and Northern Ireland), but only England.

those in Poland. In such cases, it was arbitrarily determined which subject or subjects were to be incorporated into the comparison.

Table 2. Description of science subjects taught in the examined countries.

No.	Country	Subjects	Comments
1	England	science, geography	Science may be delivered in an interdisciplinary way or divided into biology, chemistry and physics
2	Czech Republic	biology, chemistry, physics, geography, health education (Výchova ke zdraví)	Health education covers issues related to human health, some of which are delivered in Poland within biology
3	Estonia	biology, chemistry, physics, geography	The curricula of the so-called leading topics of a cross-curricular nature were taken into account – biological, geographical, chemical and technological properties of objects and processes occurring in the environment and their interconnections and interactions are discussed at lessons of specific subjects
4	Finland	biology, chemistry, physics, geography	Delivered separately, as in Poland
5	France	The subject block physics-chemistry and the subject life and Earth science, which covers biology and physical geography	The analysis did not include issues from human geography, which in France forms a part of the subject block called history-geography-civic education and is not treated as a science subject

Obtaining source documents

The core curricula in force in the countries selected for the study were collected in electronic form from the official websites of institutions responsible for drafting them or were received from employees of an embassy or consulate of a given country in Poland. At the same time, information was gathered on the status of the document in each examined country by means including interviews with employees of educational institutions during study visits to England, Finland and France.

Preparation of the tool for comparative analysis

A tool called Template for developing comparisons of core curricula (*Wzorzec opracowania porównania podstaw programowych*) was prepared to conduct the analysis, which contained the following comparative elements:

- place of the core curriculum in the education system – status of the document,
- structure of the document,
- way of including learning objectives,
- scope of content, description of skills and formation of attitudes,
- role of science subjects in development of social competences – civic attitudes,
- profile of the student completing the educational stages selected for the study.

What was superior to the aforementioned elements was the place and importance of provisions concerning the skills of scientific reasoning and applying the scientific method.

Experts

The analysis was performed by four external experts, each of whom worked independently of the others on the analysis of respective fragments of the documents referring to a given science subject. Based on the partial expert reports, the Science Section of the IBE prepared a study report.

Conclusions and recommendations

What is present and what is missing in the Polish Core Curriculum in the scope of science subjects?

The analysed documents differ in terms of structure, content and prescribed approach to the student. The differences include the degree of integration of teaching science subjects and correlations of their content. Also the emphasis placed on development of key competences (most of all social ones and using the ICT) in science education varies.



Important deficits of the Polish document, in comparison with the foreign documents, include:

- lack of a provision concerning a common central idea, guiding the science education, bonding science subjects, whose main elements shall include direct learning about nature through observation, experiments and measurements, combined with the ability to apply the scientific method, the proximity of science and everyday life, as well as recommendation to form social competences – communication, cooperation, sharing the results of work. Such an idea is clearly formulated in the core curricula in England, Estonia and France.

- low degree of integration of the teaching content of science subjects, missing cross-curricular character. The integration and interdisciplinary nature show that science subjects are in fact one, common enquiry into the world of nature (England, the Czech Republic, Estonia, France);
- the lack of problem-based approach to teaching content (which is present in the documents binding in England, Estonia, Finland), rather than studying separate topics – such as in biology – resulting from the 19th-century arrangement of natural sciences (cytology, histology, botany, zoology, etc.).

In addition, in the foreign core curricula, teaching content was found which does not exist or exists to a limited degree in the Polish document. These include:

- a section on science and application of the scientific method as common for physics, biology, and chemistry (England) or a detailed description of the scientific method (France),
- content concerning ethical and moral problems, related to scientific research and broadly understood science, as well as that concerning understanding cultural diversity and the related differing approach to the practice and achievements of natural sciences (England),
- content dedicated to the history of science (England).

The issues are presented in the Polish Core Curriculum in single points of the teaching content, namely is the specific requirements. Thus, this makes a difference in terms of the weight of the provisions.

In the analysed core curricula of the selected countries, greater emphasis was also placed on the provisions regarding the use of ICT and the project method and mathematical skills in science subjects (England, the Czech Republic, Estonia, Finland).

Differences were also noted in provisions concerning the pedagogical approach to the student. The Polish student should, above all, learn information and develop skills, while the English, Estonian and Finnish students should develop, above all, the motivation and ability to direct their own further education (England, Estonia, Finland).

What should be improved in the Polish document?

The recommendations resulting from the IBE study are of a general nature, each of them may and should be extended with detailed recommendations concerning its implementation methods. In general, the recommendations concern the educational stages analysed in the study, although some of them also cover – for substantive reasons – the other educational stages.

Based on the analyses of the conclusions from the study *Core curriculum for science subjects in selected countries*, the following changes to the Polish Core Curriculum in the scope of science subjects are recommended:

- **Formulation of a common idea to guide science education**, based on formation and development of the skills of scientific reasoning and using the scientific method;
- **Creation of a catalogue of cross-curricular skills common for science subjects**, including planning research operations (observations, experiments, measurements), diagnosing causal relations and distinguishing them from correlations and distinguishing facts from opinions. The catalogue should be common not only for science subjects, but also for all educational stages – from early years education (even kindergarten) regarding science to upper secondary schools. Such a catalogue of cross-curricular skills would determine the main direction of science education and would enable emphasis to be shifted from teaching content (encyclopaedic teaching) to learning objectives (formation and development of skills), thus ensuring a holistic approach to the whole of science education.
- **Changing the place of recommendations regarding carrying out experiments and observations and measurements**, by placing them alongside specific problems in the teaching content. This would reinforce the effect of the shift of emphasis from encyclopaedic teaching to the application of the scientific method as the basic tool of learning about nature.
- **Modification of the provisions of the teaching content of science subjects towards** the problem-based approach. This would ensure a high degree of coherence of the teaching content of those subjects – by referring the content to problems, rather than specific objects, phenomena or processes. A hierarchical arrangement of the content would enable, at the same time, retaining a high degree of detail, necessary for fulfilling the role of exam standards.
- **Adding sections concerning:** the scientific methods and the procedures employed in it (as common for physics, biology and chemistry, but also present at the second educational stage in the subject nature), ethical issues related to scientific research and broadly understood science, the history of science, which shows the continuity and cumulative nature of human effort aimed at learning the truth about the world of nature.
- **Supplementation of the core curriculum with recommendations concerning the formation and development of the students' responsibility for their own education.**

Information

More about the study

<http://eduentuzjasci.pl/przyrodnicze-podstawy-programowe>

(Polish version and a link to an English summary)



Report on the study Core curriculum for science subjects in selected countries

<http://eduentuzjasci.pl/przyrodnicze-podstawy-programowe>

(Polish and English version)

<http://eduentuzjasci.pl/en/publications/1147-core-curriculum-for-science-subjects-in-selected-countries-study-report.html>

(English version)

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The Educational Research Institute

The Educational Research Institute strengthens evidence-based education policy and practice in Poland by conducting research, analyses and other related activities in the field of education. The Institute employs more than 150 researchers specialising in education: sociologists, psychologists, educators, economists, political scientists and representatives of other scientific disciplines – outstanding specialists in their respective fields who have a wide spectrum of experience in scientific research, teaching, public administration and work in non-governmental organisations. In Poland, the Institute conducts large-scale international assessments including PIAAC, PISA, TALIS, ESLC, SHARE, TIMSS and PIRLS, as well as projects co-financed by the European Social Fund of the European Union.

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