



KAPITAŁ LUDZKI  
NARODOWA STRATEGIA SPÓJNOŚCI

IBE  *entuzjaści  
edukacji*

UNIA EUROPEJSKA  
EUROPEJSKI  
FUNDUSZ SPOŁECZNY



*STUDY REPORT*

*Part 1*

# **Best Practices in Non- Formal Science Education Survey of the Offer of Science Activities**

**Authors**

*Enzo Barevalo-Garcia, Irmína Buczek, Marcin Chrzanowski, Wojciech Grajkowski Ph.D., Jagna Hałaczek, Krzysztof Horodecki, Magdalena Kędziora, Małgorzata Musiałik, Tomasz Nowacki, Elżbieta Barbara Ostrowska, Ph.D., Urszula Poziomek, Lidia Setti, Professor Krzysztof Spalik Ph.D., Martyna Studzińska, Piotr Walicki*

**Reviewers**

*Adam Hibszer, Ph.D.*

*Maria Krystyna Szmigel, Ph.D.*

**Content editing**

*Urszula Poziomek*

*Martyna Studzińska*

**Publisher:**

*Educational Research Institute  
ul. Górczewska 8  
01-180 Warsaw  
Tel. No. +48 22 241 71 00; [www.ibe.edu.pl](http://www.ibe.edu.pl)*

© Copyright by: *Instytut Badań Edukacyjnych, Warsaw, September 2012*

Publication prepared as a part of system project: *Survey on Quality and Efficiency of Education and Institutionalization of Research Facilities* co-financed by the European Union from the European Social Fund, implemented by the Educational Research Institute.

Free copy

# Abstract

## Main Objective of the Survey

The report “Best Practices in Non-Formal Science Education. Survey of the Offer of Science Activities” is based on the studies conducted by Research Institute Millward Brown SMG/KRC S.A. for the Educational Research Institute (ERI).

The main objective of the study was to determine the manner in which the offer of science activities addressed by centres of non-formal education to groups of pupils supervised by teachers may contribute to promoting and developing scientific reasoning, an ability that is essential in science education. The research also allowed for identification of examples of best practices in the area in question.

For the purposes of the research, “best practices” were defined as follows: best practices in non-formal science education are activities and their determinants (institutional, organizational and financial) which:

- allow to formulate and test research procedures (planning and conducting tests/ experiments, observations) within the scope described in the teaching objectives and experiments and observations recommended by the new science curriculum (NSC),
- regard abilities important in science education – scientific reasoning: planning and conducting experiments and observations, formulating conclusions, discovering cause and effect relationships, differentiating facts and opinions, supporting one’s statements with rational arguments – described in the educational objectives of the new science curriculum.

## Sources of Data and Particular Objectives

The research was conducted in two stages.

**First stage:** the objective was to define the general condition of non-formal science education in Poland, taking into account the consistency of activities offered by centres of non-formal education with the educational objectives of the NSC. Another objective was to select centres for the next stage of the study, on the basis of pre-defined criteria.

The analysis was based on documents and initial data collected during a questionnaire study of a national range carried out in 2011 by associates of the Educational Research Institute (ERI). The data from 348 centres of non-formal science education were included in the analysis. The results were presented on two levels – on the national level, being a general picture, and also on the level of each of 16 voivodeships.

In addition, based on the declarative data about the centres of non-formal education (on the basis of selection criteria agreed together with the ERI), a preliminary ranking list was prepared to recruit centres for the second stage of the research.

**Second stage:** the objective was to identify and describe examples of best practices (according to the accepted definition) in non-formal science education in the country, in particular in the offer supporting the educational objectives of the NSC for groups of pupils supervised by teachers.

In each of 50 centres that were selected and agreed to participate in the research, a number of tasks was conducted: observation of two science activities run by centres of non-formal education; two in-depth individual interviews with a professional and an administrative employee of each centre<sup>1</sup>; questionnaire research with pupils/ participants of activities and their teachers/ group supervisors; analysis of programme documents and didactic materials.

## Main Research Results

Results of both stages of the research indicate that non-formal education centres in Poland have a significant potential and may be considered a valuable addition to the sector of formal education.

Almost half of the centres that participated in the ERI research in 2011 define their range of work as regional in the area of a voivodeship and one third of them as national. They mostly focus on cyclical and repetitive activities, which allow more groups to come back to the centre. The offer of the centres surveyed by the ERI associates includes, in the greatest part, activities supporting science, biology and geography. The offer of physics and chemistry is relatively poorer, which may be related to higher costs and smaller number of interested pupils (science or biology classes are addressed to preschool and primary school pupils). The didactic offer is usually based on in-house programmes; one in five centres prepares classes based on the curriculum. The methodology of classes is varied – centres not only offer expository activities (lectures, showing round the museum exposition), but also activities that potentially support development of abilities important in science education (workshops, labs).

On the other hand, qualitative research conducted in the second stage shows that the potential of non-formal education sector is related to the specific character of operation, different from schools. Non-formal education centres take advantage of the potential of other institutions – among others, universities and educational centres, the State Forests, the National Parks, and non-governmental organizations. This way, they gain access to resources and possibilities less available at schools, among them: academic or scientific staff, infrastructure, equipment, natural resources; ability to conduct business activities, achieving profit and investing in development of the centre; ability to apply methods and forms different from those used in school didactics of science (original or borrowed ideas).

Surveyed centres are not subject to regulations of the official system of education (as schools are); inter alia, they are free to design their programme, choose qualifications and education of teaching staff, as well as plan their activities. Also, they do not directly account for the results of their work the way schools do. It is mostly regulated by the free market; however, market mechanisms do not verify one aspect, important for the research: the actual usefulness of the activities offered by the centres of science education, as defined by the idea and the requirements of the NSC.

The centres have a common goal – they aim at popularizing science or its particular fields. Their other aspirations – among others, presenting the world of nature as a complex entity that can be viewed from different perspectives; enabling students to independently research and experience nature;

---

<sup>1</sup> In most cases, two interviews were conducted – one with a professional and one with an administrative employee. Yet there were cases where only one interview was conducted, covering both administrative and educational aspects – either an interview with one employee talking about both aspects, or with two employees (a professional and an administrative employee) at the same time.

introducing local natural, cultural and social resources in the context of science education – are often consistent with the general requirements of the NSC – which may indicate that there is an area of common goals between non-formal education sector and schools.

In relation to the formal education system, the centres usually adopt one of two strategies: (1) cooperation with the school – supplementing the school’s offer, supporting the school in fulfilment of duties; adjusting the offer to the NSC, both with respect to the didactic content and developed abilities; (2) separation from the school – “teaching differently than schools”; intention to distinguish the centre from the school; no interest in accomplishing didactic objectives of the school, but going beyond the school programme and methods; using the NSC as a source of information about the pupils’ level of knowledge at a given stage of education.

Representatives of non-formal education centres have identified two possible styles of cooperation of teachers with the centres: (1) committed teacher, cooperating with the centre, active in classes, supporting the staff; (2) withdrawn teacher, passive, not involved in classes, assuming the role of an observer who does not take responsibility for the results.

Representatives of non-formal education centres indicated many problems and obstacles that, in their opinion, make it difficult to conduct educational activities for groups of pupils supervised by teachers. The most important of them are:

- negative image of science among some pupils: viewed as theoretical, difficult, boring and useless in everyday life;
- decreasing level of scientific knowledge in the new classes of pupils;
- attitudes of some of the teachers choosing the withdrawn style of cooperation;
- lack of didactic training of the centre’s staff enabling conduct of classes with pupils; adjusting teaching style to different recipients, difficulties in establishing good relations with a group during one-time meetings;
- unstable legal, financial or administrative situation in some centres that impedes educational activities and efforts to use different sources of financing.

### **Examples of Best Practices Identified in the Research**

Among 50 centres that participated in the qualitative research, there is a great variety of determinants conducive to best practices – some centres demonstrate many positive aspects, often combined; others are not leaders, but in some areas also fit the definition of best practices.

Examples of best practices were identified in the centres in four areas: administration and financing, organization of activities, conduct of activities, programme documents and didactic materials.

I. In administration and financing, the following determinants have been observed:

- reaching to different sources of financing (among them European and local government funds, grants, funds from sponsors);
- taking advantage of the legal frame of the centre;
- flexible employment policy;
- professional management of information about centre’s guests (statistics, contact databases);

- optimum use of centre's own resources (staff, rooms, equipment).

II. In the area of organization of activities, the most important determinants are:

- accepting objectives or/ and didactic approach consistent with the NSC;
- connecting the offer with the NSC, adjusting it with the help from methodological advisors;
- adjusting the offer to the needs of recipients, actively developing it with the use of evaluation results;
- optimum use of resources in the centre's surroundings (natural values, social and cultural resources);
- ensuring the best service during classes (e.g. adequate number of employees for efficient conduct of classes, students' volunteer work, appointing lecturers according to their personal interests and passions).

III. In the area of conducting classes, the following determinants were identified:

- classes for small groups, work in small groups;
- use of activating methods (experiment, observation, workshop) and mixed forms (combining expository and practice-based methods e.g. seminar);
- extending classes over one standard or lesson hour;
- activities organized in programmes or cycles;
- use of didactic materials supporting students' work;
- adjusting activities to their recipients and activating participants;
- developing skills related to scientific reasoning – most often by conducting experiments and observations and defining cause and effect relationships;
- creating conditions that promote independent and creative work;
- care for commitment, arousing interest in participants and preparing them to take part in activities beforehand.

IV. In the area of programme documents and didactic materials, the following determinants were identified:

- programme documents should be prepared in a form that enables determination whether or not the centre's offer includes content consistent with educational objectives of the NSC for a given subject and whether or not it is supposed to develop skills related to scientific reasoning. Therefore, they should include information about subjects of particular classes, their general and particular objectives, content presented in class, materials used in class.
- didactic materials should include content or instructions that are directly in accordance with general and particular requirements of the NSC, and foster development of skills related to scientific reasoning. As materials, the centres should use: instructions for conducting experiments and observations, taking measurements; documents consisting of a theoretical part and didactic purposes; documents allowing for taking of notes, registering experiments or observations, and/ or their analysis, drawing conclusions; documents with instructions allowing independent and creative work.

## Main Recommendations

The most important recommendations for the formal system of education are:

- the requirements of the NSC should clearly and more directly include the offer of non-formal education centres;
- motivation system should encourage the teachers more strongly to take greater advantage of the offer of non-formal education centres;
- evaluating current knowledge of the NSC requirements among science teachers in the aspect of supplementing the school programme with activities in non-formal education centres (among others – how many teachers are aware of those requirements, have possibilities of introducing them into their classes and are willing to do so);
- promoting opportunities created by non-formal education centres among teachers in the aspect of supplementing school programmes;
- promoting the NSC among centres by presenting correspondence between the NSC and the centres' objectives, and advantages resulting from cooperation with schools in different areas;
- supporting non-formal education centres in adjusting their activities to the NSC requirements, supporting centres that have already done so;
- needs of schools and teachers should be communicated to the centres;
- stimulating cooperation between centres and the school environment, and between different centres of non-formal education.

The most important recommendations for non-formal education centres are:

- applying elements of best practices diagnosed in the research presented above;
- cooperating with schools and other centres;
- better knowledge and understanding of the NSC, in particular the general requirements (regarding skills connected to scientific reasoning), not only the teaching contents.

# Table of Contents

## *Part 1 of the Report*

<b>Abstract .....</b>	<b>3</b>
<b>1. Introduction .....</b>	<b>10</b>
1.1. Research Project Objectives .....	10
1.2. Definitions of Basic Terms Used in the Survey .....	11
1.3. Methodology and Information about Study Implementation .....	14
1.3.1. Study: Analysis of Existing Documents and Data .....	14
1.3.2. Examination of Non-Formal Education Centres – Case Studies .....	15
1.3.3. Course of Recruitment of Centres for the Study and Circumstances Accompanying Implementation.....	21
1.3.4. Study Premises and Restrictions in Interpretation of Results .....	28
<b>2. Summary of Study Results.....</b>	<b>30</b>
<b>3. Picture of Non-Formal Science Education on a National Scale .....</b>	<b>37</b>
3.1. Characteristics of the Population of Non-Formal Education Centres.....	37
3.2. Didactic and Methodological Aspects of the Offer of Science Activities for Groups of Pupils Supervised by Teachers .....	40
<b>4. Best Practices Conducive to Didactics Shaping and Developing Skills Related to Scientific Reasoning .....</b>	<b>42</b>
4.1. Area 1: Administration and Financing .....	43
4.2. Area 2: Organization of Centre's Operation .....	45
4.3. Area 3: Performance of Activities .....	48
4.4. Area 4: Didactic Materials and Programme Documents .....	52
4.4.1. Programme Documents of the Centre.....	52
4.4.2. Didactic Materials Used During Observed Activities .....	54
4.5. Examples of Best Practices Diagnosed in Non-Formal Education Centres.....	56
<b>5. Cross-sectional Analysis of the Situation Along with Evaluation and Recommendations for the Educational System, Indication of Possibilities and Opportunities Offered by Non-Formal Science Education.....</b>	<b>88</b>
5.1. Pupils from the Centre's Perspective .....	88
5.1.1. Making Pupils Interested in Sciences.....	88
5.1.2. Level of Pupils' Scientific Knowledge .....	90
5.1.3. Pupils' Preferred Style of Work.....	90

5.1.4.	Preparation of the Centre's Employees for Didactic Work .....	91
5.1.5.	Establishing Relations and the Issue of Authority .....	92
5.1.6.	Evaluation of Activities by Pupils .....	93
<b>5.2.</b>	<b>Teachers from the Centre's Perspective .....</b>	<b>93</b>
5.2.1.	Two Types of Cooperation .....	94
5.2.2.	Expectations of Centres Regarding Cooperation with Teachers vs. Practice .....	95
5.2.3.	Evaluation and Feedback on the Part of Teachers .....	98
5.2.4.	Activities of Centres Focused on Support for Teachers .....	99
<b>5.3.</b>	<b>Schools from the Centre's Perspective .....</b>	<b>101</b>
5.3.1.	Adjustment of the Centre's Offer to School Needs.....	101
5.3.2.	School Stereotype .....	101
5.3.3.	System of Limitations .....	102
5.3.4.	Teaching Style of Centres in Comparison to Schools .....	102
5.3.5.	Influence of the Age of Recipients on the Centre's Operation .....	104
5.3.6.	Activities of Centres Oriented Towards Support for Schools .....	105
<b>5.4.</b>	<b>NSC from the Centre's Perspective .....</b>	<b>105</b>
5.4.1.	Understanding the NSC by Centres .....	105
5.4.2.	Educational Aspirations of Centres .....	107
5.4.3.	Performance of Activities .....	108
<b>5.5.</b>	<b>Local Community from the Centre's Perspective .....</b>	<b>108</b>
5.5.1.	Cooperation with Local Institutions and Organizations .....	109
5.5.2.	Place and Manner of Performance of Activities .....	109
5.5.3.	Conflicts Regarding Protected Areas .....	109
5.5.4.	Consequences of Devastation of the Natural Environment .....	110
<b>5.6.</b>	<b>Sources of Financing of Educational Activity of Centres.....</b>	<b>111</b>
5.6.1.	Used Sources of Financing .....	111
5.6.2.	Voluntary Service.....	113
<b>5.7.</b>	<b>Conclusions and Recommendations .....</b>	<b>113</b>
5.7.1.	Recommendations for the Formal Education System .....	114
5.7.2.	Recommendations for Centres of Non-Formal Education.....	116

***Part 2 of the Report – detailed description of activities of 50 centres***

# 1. Introduction

The Educational Research Institute prepared a study entitled “Best Practices in Non-Formal Science Education. Survey of the Offer of Science Activities” regarding operation of non-formal education centres conducting science-themed activities for groups of pupils supervised by teachers. The activities conducted by centres support school teaching of such subjects as science at the 2<sup>nd</sup> educational stage, biology, chemistry, physics, geography at the 3<sup>rd</sup> and 4<sup>th</sup> educational stage.

The purpose of the study was to obtain information about the manner in which the offer of science activities addressed by centres of non-formal education to groups of pupils supervised by teachers<sup>2</sup> may contribute to promoting and developing scientific reasoning. The consequence of obtaining such information was selection of examples of good practices in this area. The results of the study will be used to promote methodological, substantive and organizational solutions conducive to shaping of scientific reasoning skills, and therefore consistent with the idea of the new science curriculum.

Implementation of the study was entrusted, via a tender procedure, to Research Institute Millward Brown SMG/ KRC S.A.

The study is implemented within the scope of a project entitled “Survey on Quality and Efficiency of Education and Institutionalization of Research Facilities” co-financed by the European Social Fund Within the Scope of the Operating Programme Human Capital, Priority III: High Quality of the Educational System, Sub-Measure 3.1.1.: Creation of Conditions and Tools for Monitoring, Evaluation and Examination of the Educational System.

## 1.1. Research Project Objectives

The study “Best Practices in Non-Formal Science Education. Survey of the Offer of Science Activities” had two stages.

The objective of the first stage was obtaining a general picture of non-formal science education in Poland, with special attention given to consistency of undertaken activities with educational objectives described in the Regulation of the Minister of National Education of December 23, 2008 on the curriculum for pre-school and general school education in individual school types, hereinafter referred to as the new science curriculum (NSC). The Ordering Party assumed that obtaining this picture will be a result of analysis and processing of data provided by the ERI to the Contractor and that the first stage will allow for, with the use of criteria, selection of centres assigned for an in-depth study at the second stage of the survey.

The second stage consisted in an in-depth analysis of best practices in the area of science education, with special attention given to the offer supporting implementation of educational objectives of the new science curriculum and addressed to groups of pupils supervised by teachers. Main research methods at this stage were observations of activities conducted by centres of non-formal education, interviews

---

<sup>2</sup> Due to content-related issues, the study was limited to groups of pupils supervised by teachers – this is a form where the teacher has a right to expect support in the didactic work, including compliance with the curriculum.

with professional and administrative employees of centres and questionnaire study of pupils – participants of classes and their teachers – group supervisors.

## 1.2. Definitions of Basic Terms Used in the Survey

In this survey, the following terms of key importance for the analysed issue were used: curriculum, general requirements, key competences, complex skills, best practices in science activities, non-formal science education, centres of non-formal education, science classes, centre selection criterion, programme of a centre of non-formal education.

In order to ensure clear understanding of the used terms, the definitions of these terms are provided below. The bases for their preparation were the following documents and publications:

[1] Regulation of the Minister of National Education of December 23, 2008 on the curriculum for preschool education and general education in individual school types (Journal of Laws No. 4, item 17 of January 15, 2009).

[2] Curriculum for preschool education and general education. Volume 5. Schedules 2 and 4 to the Regulation of the Minister of National Education of December 23, 2008 on the curriculum for preschool education and general education in individual school types with a commentary, Ministry of National Education, [www.reformaprogramowa.men.gov.pl](http://www.reformaprogramowa.men.gov.pl).

[3] Description of the object of order – Schedule to the Terms of Reference for *Best Practices in Non-Formal Science Education* prepared by the Ordering Party, i.e. the Educational Research Institute in Warsaw.

[4] Act on Educational System with Amendments resulting from the Act of March 19, 2009 on Changes in the Act on Educational System and Changes in Certain Other Acts (Journal of Laws No. 56, item 458).

[5] Decker F. Walker, Jonas F. Soltis, Programme and Objectives of Education, WSiP, Warsaw 2000, p. 10.

[6] Complex skills in the teaching of history and sciences. Measurement, tests with commentaries. Collective work edited by Barbara Ostrowska and Krzysztof Spalik, Institute of Philosophy and Sociology of the Polish Academy of Sciences, Warsaw 2010.

### Curriculum

Defined in the Act on Changes in Educational System Along with Changes Resulting from the Act of March 19, 2009 on Changes in the Act on Educational System and Changes in Certain Other Acts (Journal of Laws No. 56, item 458) as *mandatory sets of objectives and content of teaching, including skills, described in the form of general and specific requirements regarding knowledge and skills to be acquired by a pupil after completion of a specific educational stage and educational tasks of the school, taken into account in preschool curricula and school curricula and enabling determination of criteria for school grades and examination requirements.* [4]

### New Science Curriculum (NSC)

Regulation of the Ministry of National Education of December 23, 2008 on the preschool curriculum and general education curriculum in individual school types, commonly known as the new curriculum.

The science curriculum for the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> educational stage is contained in Schedule 2 (2<sup>nd</sup> educational stage) and 4 (3<sup>rd</sup> and 4<sup>th</sup> educational stage). [3]

### Science Subjects

Subjects taught at school, according to the Regulation of the Ministry of National Education of December 23, 2008 on the preschool curriculum and general education curriculum in individual school types: science at the 2<sup>nd</sup> educational stage, biology, chemistry, physics, geography at the 3<sup>rd</sup> and 4<sup>th</sup> educational stage (both in the basic and extended version). [3] [1]

### General Requirements

General requirements are objectives of education described in the curriculum. They inform about the manner of understanding specific requirements assigned to them, i.e. teaching content. Each general requirement may be derived from supra-subject skills (key competences), described in the initial part of the curriculum for a primary school, a middle school and a high school. [1] [2]

### Key Competences

Skills of special significance for life, development and individual and collective activities. The necessity of shaping key competences by the school is indicated by the general education curriculum.

Among most important skills acquired by a pupil during general education at the primary school are:

- 1) reading – understood both as a simple activity, as well as a skill of understanding, using and processing texts within a scope enabling acquisition of knowledge, emotional, intellectual and moral development and participation in the life of the community;
- 2) mathematical thinking – the ability to use basic tools of mathematics in every-day life and conduct elementary mathematical reasoning;
- 3) scientific thinking – ability to formulate conclusions based on empirical observations regarding nature and the society;
- 4) ability to communicate in the native language and in a foreign language, both in speech and in writing;
- 5) ability to use modern information and communication technologies, including search for and use of information;
- 6) ability to learn, understood as a manner of satisfying the natural curiosity of the world, discovering one's interests and preparation for further education;
- 7) teamwork skill. [1]

### Complex Skills

"Complex skills are understood as such skills, which refer to critical thinking or to the elements of abstraction, to thinking in the category of a phenomenon, a strategy or inter-dependence of various elements of a system or a process. Skills of this type enable association of specific messages, understanding terms that are used, perception and formulation of cause-and-effect relations and processing of information held. Subsequently, they may lead to deepening and co-creation of knowledge understood as combination of information and skills, both simple and complex." [6]

### **Non-Formal Education**

Education/ training/ learning which does not directly lead to acquisition of qualifications, implemented within the scope of programmes organized by various entities (e.g. employers, civic organizations, as well as universities, schools and individual persons). [3]

### **Centres of Non-Formal Education**

Non-governmental organizations, universities, research centres of the Polish Academy of Sciences, scientific centres, industrial centres with research or educational centres, as well as centres operated by natural persons (e.g. a private museum).

The study *Best Practices in Non-Formal Science Education* includes centres which have science activities for pupils or groups of pupils supervised by teachers in their offer, supporting school education at the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> educational stage (together or separately), including support for the new science curriculum. [3]

### **Non-Formal Science Education**

Teaching/ training/ learning with respect to science classes which does not directly lead to acquisition of qualifications, implemented within the scope of programmes organized by various entities (e.g. employers, civic organizations, as well as universities, schools and individual persons) called centres of non-formal education in the study entitled *Best Practices in Non-Formal Science Education*. [3]

### **Programme of Operation of a Non-Formal Education Centre**

Description of objectives, materials, activities and organization, intertwined with a plan of operation and presented by the centre in the programme document, such as: own (in-house) programme, programme of another centre modified for own needs, syllabus, etc. [5] [3]

### **Science Classes**

Classes organized by centres of non-formal education related to one or several science classes, with the use of such forms and methods as presentation, lecture, field trips, seminars, conferences, experiments and observations in the field or laboratory conditions.

The study *Best Practices in Non-Formal Science Education* focused on science classes whose beneficiaries are groups of pupils supervised by teachers. [3]

### **Best Practices with Respect to Science Classes Performed by Non-Formal Education Centres**

In the study *Best Practices in Non-Formal Science Education*, best practices are understood as such activities and determinants related to them (institutional, organisational and financial), which:

- allow for formulation of research procedures and their testing (planning and implementation of experiments, observations) within a scope described in education objectives and recommended experiments and observations of the new science curriculum;
- refer to skills important in science education – related to scientific reasoning, such as planning and implementation of experiments and observations, formulation of conclusions, determination of cause-and-effect relations, distinguishing opinions from facts or supporting one's own stance with material arguments, described by the educational objectives of the new science curriculum. [3]

### **Selection Criteria of a Non-Formal Education Centre for In-Depth Studies**

Information qualifying the centres for evaluation of probability of occurrence of classes implementing the premises of the new curriculum, obtained as a result of the ERI field studies.

## **1.3. Methodology and Information about Study Implementation**

### **1.3.1. Study: Analysis of Existing Documents and Data**

The first part of the study consisted in analysis of existing documents and data, derived from the questionnaire study performed in July, August and September 2011 by the ERI associates in the area of 16 voivodeships regarding non-formal science education and information collected by the Contractor as a result of analysis of documents and information on the Internet sites of centres of non-formal education indicated by the Ordering Party. The object of the analysis and the study were all data that were made available; special attention was given to activities addressed to groups of pupils supervised by teachers.

In the study, two objectives were met:

- obtaining a picture of non-formal science education in Poland with special attention given to cohesion of activities undertaken by non-formal education centres with teaching objectives contained in the new science curriculum;
- criteria-based selection for the in-depth study in the 2<sup>nd</sup> part of these centres that may potentially contribute to the shaping and development of scientific reasoning skills, which are important in science education;

The purpose of analysis of data submitted by the Ordering Party was selection of centres which:

- have an educational offer addressed to groups of pupils supervised by teachers;
- support school teaching of science subjects, such as science, biology, physics, chemistry, geography;
- constructed their didactic offer being guided by the provisions of the new science curriculum;

- in their offer, they take into account conduct of classes with methods that may support the teaching of scientific reasoning, e.g. workshops, labs, field trips, identification of species, scientific shows;
- declare that in the course of the activities, they use didactic materials and aids which may support the shaping of scientific reasoning.

The Ordering Party provided data about 348 non-formal science education centres, where the ERI associates implemented the study. The population of the examined centres was examined in detail in Chapter 3 "Picture of Non-Formal Science Education on the National Scale." A questionnaire prepared by the Ordering Party for the needs of the study implemented by the ERI associates in 2011 was used.

### **1.3.2. Examination of Non-Formal Education Centres – Case Studies**

The second stage of studies consisted in performance of quality studies in 50 selected centres of non-formal education. Its purpose was diagnosis and description of examples of best practices in the area of non-formal science education on the national scale, with special attention given to the offer supporting the implementation of educational objectives of the new curriculum, addressed to groups of pupils supervised by teachers.

#### **Selection Criteria of Centres for In-Depth Study**

The main purpose of reviewing the full offer of 348 centres of non-formal education (1<sup>st</sup> stage of study) was to select centres assigned for an in-depth study. On the basis of declarative data provided by the Ordering Party about the centres of non-formal education, their ranking was prepared according to the estimated probability of identification of best practices in a given centre – within the meaning of the definition formulated for the needs of this study.

Initially, from the list of information about individual centres, these centres were selected with respect to which a research hypothesis was formed that on their basis it is possible to draw initial conclusions about extraordinary probability of occurrence of classes implementing the premises of the new curriculum. The list of information qualifying such centres for evaluation of such probability was determined as a list of criteria.

In the initial version of the list, an extended version of the criteria was presented to the Ordering Party, taking into account:

- character of activities (ongoing, cyclical or incidental);
- payment due partially or in whole for participants (for activities, materials or entry to the centre);
- support for implementation of the idea of the new curriculum, understood in a manner that the centre creates opportunities for the teacher to use an offer that enables for teaching skills determined as important; declaration that the curriculum constitutes a basis for the implemented activities or declared own programme documents;
- offered methods of activities and dominant methods of activities (workshops, labs, field trips, scientific shows, marking of species – plants, animals, birds);

- character of materials received by the participants during activities (worksheets, natural specimens, equipment for laboratory classes, equipment for field trips, e.g. nets for insects, binoculars, identification keys, multimedia presentations, models).

Every criterion was assigned a proposal of point weight, reflecting the utility of given information for the needs of the prepared ranking. After presentation of an initial version of applying the above criteria, expert analysis of the obtained results was performed and a new attempt was made at evaluating the possessed data from the point of view of their utility for the purpose of the prepared ranking.

As a result of analysis of effects of the first study and quality analysis of available declarative data, in line with the expert decision of the Ordering Party, it was decided that the criteria qualifying for the study will be limited solely to the criteria referring directly to the curricular aspect and the methodological aspect of the conducted activities. What is more, point weights assigned to individual criteria were also calibrated.

Finally, it was assumed that declarations regarding application of the curriculum or other programme documents of the centre are particularly informative on account of the objective of the study. In relation to the above, the following data regarding programme documents were selected and the following weights were assigned to them:

- a) a curriculum declared as a basis for the performed activities – 8 points;
- b) at least one other declared document with respect to work in the centre – 6 points.

As a maximum, a centre could receive 9 points for information regarding support for implementation of the curriculum; 8 for a declaration of using the curriculum and 1 extra point if any other own programme document was also indicated.

In the case of the methodological aspect, a proposal was made to select only these methods and materials received by the participants of classes whose application may influence the increase of activity of class participants and, via this, potentially, the shaping and the development of skills constituting scientific reasoning. At the same time, it was assumed that a passive stance of a participant of activity, related to application of direct instruction methods, is not conducive to, and even prevents development and shaping of skills, in particular skills described in the definition of best practices.

In line with the final expert decision of the Ordering Party, answers of the respondents to four questions from a telephone questionnaire were used, determined as ranking criteria. Each of the selected answers was assigned a weight approved by the Ordering Party, reflecting utility of a given piece of information for the needs of the ranking, according to the assumptions below:

**Table 1. Point-award principles in final criteria**

Question	Content	Point award principles
Question 8	<i>In which form and with the use of which methods are the activities conducted (more than one answer can be selected)?</i> 1. lectures	Methods of activities – maximum 4 pts. workshops – 3 pts. labs – 3 pts.

	<p>2. <i>workshops</i></p> <p>3. <i>labs</i></p> <p>4. <i>showing a museum collection</i></p> <p>5. <i>others, which</i></p>	<p>field trips – 3 pts.</p> <p>scientific shows – 1 pts.</p> <p>marking of species (plants, animals and birds) – 3 pts.</p>
Question 9	<p><i>Which of the forms indicated in question 8 is dominant during science activities?</i></p>	<p>Dominant methods of activities – maximum 4 pts.</p> <p>workshops – 3 pts.</p> <p>labs – 3 pts.</p> <p>field trips – 3 pts.</p> <p>scientific shows – 1 pts.</p> <p>marking of species (plants, animals, birds) – 3 pts.</p>
Question 10	<p><i>With respect to methodology and substance, the activities are based on (more than one answer can be selected):</i></p> <p>1. <i>own programme;</i></p> <p>2. <i>syllabus;</i></p> <p>3. <i>curriculum of the Ministry of National Education;</i></p> <p>4. <i>other documents, which .....</i></p> <p>99. <i>no such documents/ programme.</i></p>	<p>Support for implementation of curriculum – maximum 9 pts.</p> <p>curriculum declared as a document constituting a basis for the performed activities – 8 pts.</p> <p>any other, at least one, declared document for work in the centre – 6 pts.</p>
Questions 13 and 14	<p>13. <i>Do the participants of activities receive any didactic materials in the course of activities?</i></p> <p>14. <i>If yes, what kind of?</i></p>	<p>Type of materials received by the participants during activities – maximum 5 pts.</p> <p>worksheets – 3 pts.</p> <p>natural specimens – 3 pts.</p> <p>equipment for laboratory classes – 4 pts.</p> <p>equipment for field trips, e.g. nets for insects, binoculars – 4 pts.</p> <p>keys for identifying organisms – 1 pts.</p> <p>multimedia presentations – 1 pts.</p> <p>models – 1 pts.</p>

For each of the questions, a point index was calculated in the following manner:

- if the centre did not indicate any of the answers with points, 0 points were granted;
- if the centre indicated one answer with points, it received the number of points assigned to it;
- if the centre indicated more than one answer with points, it received the greatest number of points assigned to the indicated answers and additionally 1 point for variety of its activities.

Subsequently, points from all questions were summed up, creating evaluation of attractiveness of the centre as a candidate for the 2<sup>nd</sup> stage. The evaluation ranges from 0 to 22 points for various centres.

The centres were sorted according to this grade, creating a ranking, on the basis of which recruitment of centres for the quality study was made.

The table below contains a list of centres where, under the completed recruitment, quality studies were conducted. Information about the course of the recruitment and causes for variation of places in the ranking are presented in sub-chapter 1.3.3.

**Table 2. List of centres where quality studies were conducted.**

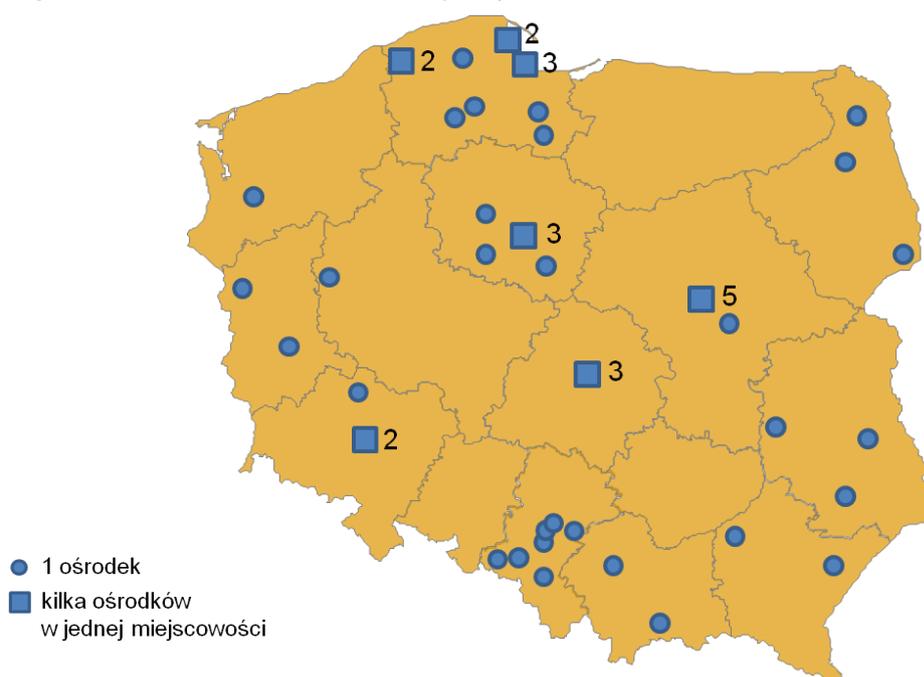
No.	Place in ranking	No.	Name of Centre	Location	Voivodeship
1	2	216	Small Scale Chemistry Centre Chemistry Didactics Division, Faculty of Chemistry, Nicolaus Copernicus University	Toruń	Kujawy and Pomerania
2	3	4062	Nature Museum of the Faculty of Biological Sciences of the University of Zielona Góra	Zielona Góra	Lubuskie
3	7	1225	Physics Didactics Division, University of Silesia	Katowice	Silesia
4	10	1105	Culture Park of City Fortifications	Gdańsk	Pomerania
5	12	107	Environmental Education Centre in Krośnice	Krośnice	Lower Silesia
6	13	201	Kujawy and Pomerania Centre for Ecological Education in Bydgoszcz	Bydgoszcz	Kujawy and Pomerania
7	15	729	Botanical Garden of the University of Warsaw	Warsaw	Masovia
8	17	1103	EduPark Centre of Education for Children and Youth at the Gdańsk Science and Technology Park	Gdańsk	Pomerania
9	20	1228	Biology Didactics Division, University of Silesia	Rybnik	Silesia
10	24	505	Ecological Education Centre "In the Łagiewniki Forest" Branch No. 2 Centre of Out-of-School Activities No. 1	Łódź	Łódź
11	27	1110	Gniew Centre of Ecological Education by the Association Centre for Active People in Gniew	Gniew	Pomerania
12	29	1122	University for Children Pomeranian Academy in Słupsk	Słupsk	Pomerania
13	37	606	Museum of Municipal Engineering in Cracow	Cracow	Lesser Poland
14	38	1624	Solec Jurassic Park	Solec Kujawski	Kujawy and Pomerania
15	40	1002	Biebrza National Park – Centre of Education and Management	Goniądz	Podlasie
16	41	1102	EXPERYMENT Science Centre	Gdynia	Pomerania
17	42	1210	Earth and Us Association Centre for Ecological Education	Dąbrowa Górnicza	Silesia
18	43	1212	Coal Mining Museum in Zabrze	Zabrze	Silesia

No.	Place in ranking	No.	Name of Centre	Location	Voivodeship
19	43	1211	Moravian Gate Arboretum in Racibórz	Racibórz	Silesia
20	47	1219	Ecological Education Centre Representative Bison Pen	Pszczyna	Silesia
21	48	1220	Upper Silesian Museum in Bytom	Bytom	Silesia
22	55	102	"Planetarium" Astronomy Didactics and Popularization Division	Wrocław	Lower Silesia
23	58	113	ZOO in Wrocław - Spółka z o.o. – Marketing and Education Division	Wrocław	Lower Silesia
24	61	202	Włocławek Centre for Ecological Education	Włocławek	Kujawy and Pomerania
25	63	209	Zoobotanical Garden in Toruń	Toruń	Kujawy and Pomerania
26	65	407	"Warta Estuary" National Park – Natural Garden of Senses	Górzycza	Lubuskie
27	66	501	Centre for Environmental Activities "Źródła"	Łódź	Łódź
28	68	703	BioCentre for Science Education	Warsaw	Masovia
29	70	911	Environmental Education Centre in Przeclaw at the Municipal Cultural Centre	Przeclaw	Podkarpackie
30	71	920	Forest Education Chamber, Jarosław Forest Inspectorate	Jarosław	Podkarpackie
31	76	1101	Centre for Ecological Information and Education	Gdańsk	Pomerania
32	78	1114	Gdynia Aquarium of the Maritime Fishing Institute – State Research Institute	Gdynia	Pomerania
33	79	1116	Pomerania Complex of Landscape Parks in Słupsk, Complex Division in Kościerzyna, Wdzydze Landscape Park	Kościerzyna	Pomerania
34	80	1124	Pomerania Complex of National Parks, "Słupia Valley" Landscape Park Division	Słupsk	Pomerania
35	95	617	Pieniny National Park	Krościenko nad Dunajcem	Lesser Poland
36	98	302	Roztocze National Park	Zwierzyniec	Lublin
37	101	1001	Centre for Nature Education of the Białowieża National Park	Białowieża	Podlasie
38	102	1104	Eco-Initiative Association	Kwidzyn	Pomerania
39	103	1115	Green School in Schodno	Dziemiany	Pomerania
40	111	1507	Centre for Regional and Natural Education in Mniszki	Mniszki	Greater Poland
41	114	1601	Dendrological Garden, Local Budget Unit in Przelewice	Przelewice	Western Pomerania
42	123	1004	Alfred Litiński Wigry Museum, Wigry National Park	Suwałki	Podlasie

No.	Place in ranking	No.	Name of Centre	Location	Voivodeship
43	135	211	Forest School in Barbarka	Toruń	Kujawy and Pomerania
44	138	301	Polesie National Park	Urszulin	Lublin
45	140	307	Nature Museum, Division of Vistula Museum	Kazimierz Dolny	Lublin
46	143	508	Directorate of the Łódź Hills Landscape Park	Łódź	Łódź
47	146	702	Copernicus Science Centre	Warsaw	Masovia
48	150	712	National Centre for Nuclear Research	Otwock-Świerk	Masovia
49	233	725	Warsaw University, Faculty of Physics	Warsaw	Masovia
50	233	723	Museum of Technology	Warsaw	Masovia

The map below indicates location of centres where quality studies were conducted:

**Map 1** Location of 50 centres where quality studies were conducted



[one centre; several centres in one location]

### Description of Quality Study

In every centre from the group of 50 centres that were selected and agreed for the study, the following tasks were implemented:

- observation of two science activities conducted according to an activity observation instruction by a trained observer – a teacher familiarized with the NSC;

- conduct of an in-depth interview with persons responsible for professional and administrative operations of a centre, according to an interview scenario by an experienced moderator<sup>3</sup>;
- evaluation of classes with respect to their utility in the school teaching of science and development of interests of their recipients – questionnaire study of the teacher/ group supervisor and pupils/ participants of classes;
- analysis of didactic materials of the centre used during the observed activities with respect to their relation to teaching objectives described in the NSC, performed according to an analysis form of didactic materials by a trained observer – a teacher familiar with the NSC;
- analysis of the centre's documents constituting the basis for the conducted activities (programme documents) with respect to their relation to teaching objectives, described in the science curriculum, performed according to an analysis form of programme documents by a trained observer – a teacher familiar with the NSC<sup>4</sup>.

Tools used at this stage of the study (observation and analysis forms, interview scenarios and questionnaires) were prepared in cooperation with the Ordering Party.

With respect to technical remarks, it has to be noted that the tools on the basis of which analyses of results were made were used by the observers at many stages (both during observations – notes, as well as after performance of observations/ analyses; finally, in the case of supplementing upon request and after asking additional questions by researchers during the conduct of analytical work), and subsequently by analysts. For the purpose of maintaining consistent character of raw data, no regressive unification was performed. Data used in the report have to be treated as data from multiple sources.

In descriptions of individual centres, terms and statements describing the operation of centres were used in a manner in which the respondents use them. These terms were not unified or corrected on purpose, in order to reflect the language, the situation and the manner of thinking prevailing in a given centre. Change of statements used by the respondents could lead to the fact that their opinions would be different than intended by our interlocutors.

### **1.3.3.Course of Recruitment of Centres for the Study and Circumstances Accompanying Implementation**

#### **Use of Results of Examination of the Offer of Science Activities Conducted by the ERI Associates**

---

<sup>3</sup> Usually, two interviews were conducted in every centre – one with a professional employee and one with an administrative employee. There were also situations where one interview was conducted with an employee who talked both about professional issues and administrative issues, as well as situations where an interview was conducted at the same time with two employees: professional and administrative (the so-called dyad).

<sup>4</sup> Internet sites of centres were not subject to analysis. Sometimes, when asked about programme documents, the centres indicated the Internet site as the only form of their presentation. In such a case, they were asked to indicate a specific document/ link / sub-page and only a fragment of the page as a programme document of the centre was subjected to analysis.

In July 2011, the associates of the Educational Research Institute studied the offer of science activities of non-formal education centres in Poland. The centres were most often contacted via telephone.

Institute Millward Brown SMG/KRC performed, between March and May 2012, upon the commission of ERI, another stage of studies. Out of centres contacted in 2011, these centres were selected whose educational offer allowed for expecting high probability of occurrence of best practices with respect to the teaching of science within the meaning of the purposes of this study. As a result of evaluating this probability, a list of centres was prepared which was used for recruitment, starting from centres with respect to which the probability of diagnosing best practices was estimated as highest, which is described in detail in Chapter 1.3.2.

A definite majority (36 centres out of 50 examined) were recruited from the first hundred, according to their place in the prepared list.

During the recruitment interview, information was collected with the aim of qualifying centres for the study, as well as obtaining approval for participation in the entire research process.

The recruiters established contact with subsequent centres from the list, occupying places from 1 to 200. Eventually, 50 centres were recruited, where the study was performed in line with the premises.

### Recruitment Stages

The recruitment of centres was divided into two stages: stage of technical recruitment and stage of expert recruitment in order to additionally maximize the probability of occurrence of best practices during the observed activities.

Both stages of recruitment were implemented as a telephone interview, conducted with representatives of individual centres from the list. In the course of a structured talk, the task of the recruiter was to determine whether a given centre complied with the assumed recruitment criteria and whether it would agree for the conduct of full research procedure.

Expert recruitment was performed during another telephone interview with representatives of centres qualified for the study at the stage of technical recruitment. The expert's task was to conduct an unstructured talk with respect to operation of the centre and try to obtain a description of activities to which the centre invites the observers. The expert also had the possibility of suggesting selection of another activity than the activity originally proposed by the centre. Workshop or laboratory type activities were preferred rather than lectures, assuming that activities activating pupils or entailing interaction with the person conducting the activity have a greater chance at complying with the criteria adopted in the project as defined as best practices.

#### ■ Technical Recruitment

Among most important issues confirmed at the first stage of recruitment was to obtain information whether a centre:

- still exists and operates;
- will conduct activities for groups of pupils supervised by teachers in March and April 2012;

- plans activities supporting teaching of sciences: biology, chemistry, physics, geography at the 3<sup>rd</sup> and 4<sup>th</sup> educational stage or science at the 2<sup>nd</sup> educational stage;
- approves the conduct of the study, in line with the assumptions of the study.

### ■ Expert Recruitment

The recruitment process was extended onto the quality criterion of expert recruitment, whose purpose was last verification of information obtained during studies conducted by the ERI in 2011 before performance of the study. The expert recruitment consisted of, as assumed, additional verification for the obtained ranking. During an unstructured telephone conversation with the professional employee of the centre, the expert attempted to determine the probability of occurrence of best practices of applying the idea of the NSC in a given centre, inter alia by talking about the classes to which observers were invited. In case there was such possibility, the expert selected classes with respect to which he/ she voiced an assumption of highest probability for identifying best practices within the meaning of study premises. Therefore, such classes as workshops or labs were preferred by the experts; further, there were talks, lectures or presentations.

During the talk about the centre, the expert could refer to data accumulated previously; however, main questions referred to the nature of current activities in a given centre with an emphasis on individual and unique elements, in particular original ideas of the centres, which the authors would like to share. At every recruitment stage it has been emphasized that both the concept of activities and own materials of the centre would be treated as confidential.

In-depth questions also referred to the type of skills developed during activities in the centre, the character, purpose and, sometimes, the course of activities.

In two cases, there were doubts with respect to the possibility of identifying best practices in centres and the expert did not provide a positive recommendation with respect to a given centre's participation in the study.

### Additional Premises of the Recruitment Process

In the study, an additional quota criterion was adopted in the sample – a minimum of 3 for every science subject, so that observations referred to activities supporting various science subjects. In place of the previously unplanned pilot stage, the first five observations were implemented in centres selected by expert decision of the Ordering Party, called “centres under special supervision.” The Ordering Party's expert knowledge about operation of such centres deriving from sources other than the study indicated significant chances for encountering best practices there. On account of time restrictions, only two were examined – the Copernicus Biocentre and the Centre of Science. Application of this procedure allowed for – in line with the assumption – introduction of corrections in the activity observation chart and in the procedures of recruitment and study implementation.

### Consequences of Applying a Complex Recruitment Process

The ultimately determined combined recruitment criteria and a multi-stage recruitment process are determined as highly complex, which significantly influences the extension and the increase in the level of difficulty of the complete recruitment process, as well as implementation of the entire study. In the light of the obtained results, it seems that the difficulty of the process was justified, even though it

led to a further, serious shortening of the exceptionally short period foreseen for analyses of collected data and work on the final report.

An additional factor extending the recruitment process was exceptionally long - sometimes lasting several weeks - process of making decisions about approval or lack of approval for participation in the study on the part of a centre.

It is necessary to remember that the applied multi-stage character and complexity of the recruitment process translate into multiple contacts with various representatives of the centre, in particular with persons:

- informed about the schedule and nature of activities;
- authorized to express approval for the conduct of study in the centre;
- competent to conduct talk on behalf of the "Centre Guardian" whose task was collection of materials about the centre and didactic materials, distribution and collection of questionnaires, support for the observer in his/ her research activities in the course of observations, etc.

On the one hand, multiple contacts with various employees of the centre encumbered and extended the recruitment process, yet on the other they led to contacts with various persons employed in the centre, sometimes spanning the period of many weeks.

In certain cases, it was possible to get an impression that such intensive contacts, repeated throughout the weeks, could have been considered almost burdensome. This was of special significance in the case of centres which were not able to make or communicate the final decision about the approval for participation in the study. Absence of a clear refusal to participate in the study led to multiple contacts on the part of the Contractor, yet the final number of permitted contacts with a given centre was determined on a one-to-one basis, individually. The decision about the end of the process of recruitment and cessation of further contacts in spite of lack of refusal on the part of the centre was made, most often, on the basis of an expert decision of an experienced recruiter. Meanwhile, it seems that many centres were addressees of a request for participation in such research project for the first time, which may be related to lack of awareness with respect to the possibility of refusing participation in the study. Originally, it was assumed that five ineffective contacts with a centre would be treated as a refusal. However, in practice the number of contacts was significantly increased, so that centres from the beginning of the list took part in the study. Also, some centres encouraged more numerous contacts by providing contact data to subsequent persons for the purpose of obtaining approval for participation in the study or further information.

When planning the centre recruitment schedule, it is worth paying attention to the most common course of the recruitment process, which may be usually divided into several stages, such as:

1. Establishing contact

The time necessary for establishing contact with a centre, determination of persons competent for a recruitment talk and establishing contact with a decision maker in practice takes at least 3 – 4 days.

2. Sending a formal announcing letter

After the first telephone contact, it was necessary to send an e-mail or a fax with an announcing letter which – usually not directly – reached the interested person and the person authorized to represent the centre and to decide about participation in the study. The fact whether the letter reached the competent addressee had to be monitored on an ongoing basis.

### 3. Contact for the purpose of collecting information about the decision

At a further stage, telephone contacts were repeated with a question about the decision on the centre's participation in the study. Frequently, the decision was not made immediately, often on account of unavailability of the decision maker or due to other reasons on the part of the centre, for example the decision maker's inability to become efficiently acquainted with the announcing letter. The time necessary for establishing contact at this stage was frequently extended to several weeks and sometimes to over a month, counting from the moment of sending the announcing letter.

It is also worth noting that in the case of several out of 50 centres, recruitment was performed very efficiently and lasted only 2 – 3 days. This referred to centres which were particularly intent on participating in the study and sharing their experiences. Persons representing such centres put a lot of effort to efficient selection of activities for observations, agreeing an interview with an expert, obtaining and sending written approval of the decision maker for the study and finally – agreeing on individual interviews with the centre's employees within a reasonably short time.

However, this stance cannot be determined as typical for the centres, because it referred to a definite minority.

## Reasons for Exclusions

The study encompassed centres recruited from the list. Among the recruited centres, there were many centres subject to exclusion from the study due to relatively various reasons, such as:

### 1. Complex recruitment procedures

The study had complex recruitment procedures which resulted from incomplete knowledge about the manner of functioning of the centre, such as availability of decision makers or the period of conducting classes, length and nature of activities or didactic modules (imprecise or varying duration of activities), incidental nature of activities (deciding that an activity would take place a short time before its implementation), changing of dates (annulment or postponement of classes), etc.

### 2. No activities in March

A significant part of centres makes organization and conduct of their activities dependant on the weather, due to the fact that these are often didactic paths or field trips. Due to this, they are organized most often in April and May when the probability of weather conducive to such activities is higher. It also seems that May activities in non-formal education centres have more interest on the part of schools rather than, for example, activities organized in March.

### 3. Required structure of activities

Many centres did not qualify for the study on account of too short duration of offered activities (e.g. 30 – 40 minutes); sometimes, only one activity with one group took place on a given day and it was impossible to agree on observation of another activity, required in the study premises, etc.

### 4. No activities complying with criteria

Numerous centres from the recruitment list do not conduct activities complying with the recruitment criteria determined by the Ordering Party; for example, they only offer activities for preschool children, many of the activities are not offered to organized school groups, and only for individuals expressing such willingness, contestants, high school graduates or candidates for specific studies, as in the case of numerous activities organized by universities. The provided list of centres did not include full information about the nature of conducted activities and was superannuated in a certain respect, which in many cases led to exclusions from the study.

#### 5. Small number of activities in the centre

Centres operating vigorously and without break, where activities take place daily or almost every day and where it is possible to select classes interesting for observation from the point of view of the study are a rarity. Activities in the recruited centres usually take place several times a month and often only once or twice a month. It is a standard situation where a centre organizes an activity only after specific order from a school or a group of pupils.

#### 6. Problems with centres and their operation

In few cases, it turned out that the centre from the list prepared last year does not exist anymore, is in the process of liquidation, is being renovated or does not currently offer activities, for example due to the lack of funds. Few centres also declared that they do not offer own activities and only lease rooms and make didactic aids available, whereas activities are conducted by a teacher who comes to the centre with a group of pupils.

#### 7. Refusals

In certain cases, refusal was dictated by the centre's management's conviction about low efficiency of studies as such and no possibility of the results' impact on improvement of the centre's situation. In some cases, refusals resulted from perception of the research method as overly invasive; for example, it was claimed that an observer may distract the group or that the planned individual interviews are too long. It is necessary to remember that prolonged lack of a positive decision with respect to the centre's participation in the study was also treated as refusal.

#### 8. Further causes for problems in recruitment

It is necessary to draw attention to the fact that the above-listed reasons for exclusions often occurred together and sometimes appeared only after many weeks of implementing the process, in spite of the initial approval of a centre.

It is worth noting the necessity of observing top quality of the prepared list of centres for recruitment. In particular, it is necessary to draw attention to absence of mistakes, repetitions or errors in assigning telephone numbers to centres, as well as validity and completeness of contact data of centres.

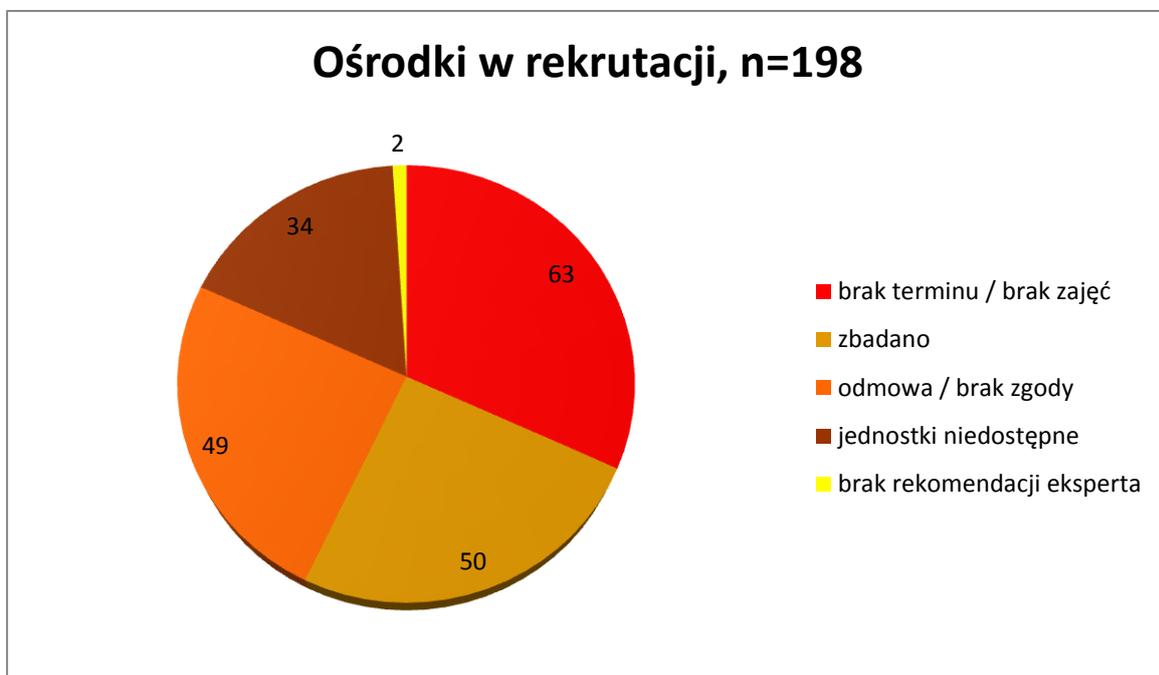
### **Breakdown of Reasons for Exclusions**

198 centres from the prepared recruitment list participated in the recruitment process. The study encompassed 50 centres, in line with the premises. The most important reason for exclusion of a centre from the study was absence of relevant activities or offering such activities outside the study implementation schedule, which referred to 63 centres. Refusal or lack of confirmation for the centre's

positive decision referred to 49 centres and no possibility of contacting the centre resulted in classification of 34 centres as unavailable.

It is necessary to note that a definite majority of units described as unavailable were centres from the last quarter of the list, i.e. centres included in the recruitment process as last, at the end of the recruitment process. Therefore, unavailability of such centres results more often from the fact that attempts at establishing contact with them were made only few times and within a short period of time. After efficient recruitment of the required number of 50 centres, contacts with many of them were abandoned, which caused marking them as unavailable units only on the basis of few attempts at contact. As a result of expert recommendation, only two centres from the recruitment list were not included in the study.

**Fig. 1** Results of recruitment of centres for the quality study



[centres in recruitment, n=198

no dates/ no activities; examined; refusal/ lack of approval; unavailable units; lack of expert recommendation]

### Recommendations

In the case of planning subsequent studies on the non-formal education centres, it is worth considering numerous elements of the research process, aimed at streamlining the study process and assurances of top quality of the collected data with simultaneous maintenance of a non-invasive nature of contacts with centres, which, in particular, refers to the scope of work to be performed in the centre and the dates of study performance.

In case studies of similar scale of encumbrance of a centre are planned, it is worth implementing strict procedures preventing excessive number of contacts with the centre in order not to discourage the representatives of centres of non-formal education to studies in the future. Taking into account the

scope of work in the centre assumed by the Ordering Party, the scale of the research project encompassing 50 centres, as well as its pioneering nature, it is necessary to draw attention to difficulties resulting from lack of planning of the pilot phase, assigning a too short period of time for implementation of project in the field and exceptionally short period for preparation of results, which had additional significance with respect to prolongation of the recruitment process and study implementation.

#### 1.3.4. Study Premises and Restrictions in Interpretation of Results

The following premises regarding implementation of studies have impact on limiting the interpretation of results:

- selection of a field of interest; only science activities for groups of pupils under supervision of a teacher and, at the same time, omitting other areas of activity of examined centres;
- searching for activities which may constitute a source of best practices within the meaning of the adopted need of examining the definition of best practice (which means, inter alia, preference for labs, workshops and field studies);
- reliance on evaluation of two selected science activities for groups of pupils supervised by teachers. The aim was to observe activities lasting, on average, from 45 to 60 minutes;
- strictly qualitative nature of studies and the research sample related to it precisely and purposefully as well as research tools agreed with the Ordering Party.

Adoption of the premises above results in restrictions in interpretation of the obtained study results:

#### With respect to drawing conclusion on the level of all centres

- **Limited possibilities of generating results per population.** Centres of non-formal education were selected in a strictly purpose-oriented manner – in relation to the need of maximizing the probability of diagnosing elements of best practices in line with the definition from the Terms of Reference. Therefore, it was not a representative sample; what is more, the study itself did not have a representative character, therefore the obtained results and conclusions from the study cannot be generalized for the entire population of centres of non-formal education. It is also worth remembering that there is no database of centres of non-formal education on the national level or even at the level of individual voivodeships, which influence adoption of the premise about the quality character of the study.
- **Limited possibilities for comparing centres.** The group of non-formal education centres selected for the study is much diversified internally (they differ with respect to location, type of conducted activity, legal form or subjects within the scope of which activities are offered). Some of these differences were related to the examined determinants and influenced the condition of the centres. Among such differences, the most important variable seems to be the legal form and the facilities related to superior institutions which influence the possibilities of procuring funds for operation of the centre, access to infrastructural resources, equipment or personnel. The above-listed factors limit the possibilities of making comparisons among centres and the scope of potential recommendations which may have not included certain legal forms or forms of operation of centres.

### With respect to drawing conclusions on the level of description of individual centres:

- **Limited possibilities for generalizing the observation results of activities.** This limitation results from one purpose of the study which was the search for best practices and not comprehensive evaluation of the quality of activities offered in a given centre. Selected specific activities were subject to evaluation and the results of such observations were used to formulate conclusions with respect to occurrence of best practices in the area of performance of activities. Therefore, it is necessary to remember that such conclusions could have been different if the observer analysed different activities. If the activities observed within the scope of the study contained few elements of best practices, it does not necessarily mean that other activities conducted by the centre are devoid of such elements. Analogously, the fact that the activities complied with the majority of criteria in the adopted definition does not mean that the thesis is true in relation to all activities offered by a centre.
- **The adopted definition of best practices may result in the fact that labs or workshops have better results,** due to the fact that their form offers more possibilities for developing specific skills important in science education in comparison to, e.g., observations or field trips. This refers to such elements as the possibility of documenting results or conducting a discussion (which poses difficulties in the case of a field trip).
- **Limited possibilities for comparing opinions of teachers accompanying the groups and opinions of pupils participating in the activities.** It is necessary to bear in mind that questions regarding utility of activities in various aspects and skills developed thanks to such activities in the case of questionnaires for teachers and pupils were formulated in various manners – to adjust the tools to the potential of respondents. The scope of collecting teachers' opinions could have been wider; some aspects of utility and skills were reformulated or omitted in the case of questionnaires for pupils (additionally, the questionnaire for the second stage of education was simplified and some statements were omitted).

**External factors** are also related to limitations in interpretation of study results, which influence the picture of a centre obtained in the study and the activities offered by it. Such factors were independent from the premises and the criteria adopted in the study and remained outside the researchers' control potential. Among the most important ones, it is necessary to list characteristics of a group that participated in a given activity:

- profile of a class – on the level of senior high schools, science activities attended by classes with a scientific profile (e.g. biology/ chemistry, electro-technical) were evaluated as closer to best practices, which is indirectly related to factors such as interest, preparation and motivation of pupils for participation in the activity;
- interest of pupils in a given area of science or subject of an activity – presence of uninterested pupils aggravated the atmosphere during the activities and hindered conduct of activities in a manner which would bring them closer to the criteria of best practices (e.g. on account of the necessity of activating passive persons);
- prior preparation for participation in activities (such as already possessed knowledge and skills) – according to the observers, activities attended by pupils who had prior preparation (during school classes or prior activities) or pupils possessing some knowledge in a given area had much better results;

- discipline among pupils – in groups where there were undisciplined pupils, who behaved inappropriately, the activities had worse scores and it was more difficult to conduct them in a planned manner;
- number of pupils in the class – even though some centres stipulated the maximum number of activity participants, this factor, which only the schools may influence, is of great significance. The larger the class, the more difficult it was to conduct an activity complying with best practice criteria;
- the pupils' motivation to participate in the activity – activities attended by pupils who were focused on the educational objective had better results (e.g. getting a better grade, preparation for an exam, interests) than entertainment (e.g. a trip perceived as entertainment for the whole class, the necessity of organizing free time during exams);
- stance of group supervisors – even if the teachers accompanying the group did not participate in the conduct of activity, their stance influenced the behaviour of young people; the teacher's interest in the subject had beneficial impact on the behaviour and stance of young people.

## 2. Summary of Study Results

The study offers a basis for formulating a hypothesis that the sector of non-formal education centres in Poland has a significant potential and may be an enriching supplement for the sector of formal education.

Almost half of the centres that participated in the research of the ERI associates defined their range of operation as regional in the area of a voivodeship and one third as national. They mostly focus on cyclical and repetitive activities, which allow for more groups to come back to the centre. The offer of the centres surveyed by the ERI associates includes, in the greatest part, activities supporting such subjects as science, biology and geography. The offer with respect to physics and chemistry is relatively poorer, which may be related to higher costs and smaller number of interested pupils (science or biology classes are addressed to pupils attending preschools and primary schools). The methodology of classes is varied – centres not only offer expository activities (lectures, showing round the museum exposition), but also these that potentially support development of skills important in science education (workshops, labs).

Non-formal education centres encompassed by the quality study address their offer to individual recipients, but also – and primarily – to schools, groups of pupils supervised by teachers and to teachers (teacher training offer).

The potential of the non-formal education sector is related to slightly different specifics than the specifics characteristic for operation of schools. Centres of non-formal education rely on the potential of other institutions – including universities and scientific centres, units of State Forests or National Parks or non-governmental organizations. Thereby, they acquire access to resources and potential not encountered so often in schools. Among most important of them are:

- scientific and didactic personnel: employees involved in research activity, having newest knowledge in the area of sciences and access to new publications, discoveries from the area of sciences;

- infrastructure and equipment: access to modern, extensive equipment and infrastructure (e.g. laboratory) and potential (and justification) for investing in such resources;
- scientific aids, museum exhibits;
- natural resources: access to resources such as parks, nature reserves, reservoirs, bird habitats and others;
- possibility of conducting gainful activity and investing in development of own units;
- possibility of applying forms and methods other than adopted in school didactics of sciences within the scope of own ideas or borrowed models.

At the same time, it is necessary to note that not all centres have access to the above resources or potential or that they make efficient use of them.

Centres of non-formal education are not subject to regulations which encompass schools within the scope of the system of education – they are free to shape their programme offer, qualifications and level of education of the employed didactic personnel and have freedom in planning their activity. Moreover, they do not directly account for the effects of their didactic work in a manner comparable to schools – their work is not verified by tests, grades, visits or external examinations. They are also not subject to pedagogical supervision and representatives of centres sometimes indicate that they lack a broader didactic preparation.

The centre's work is verified primarily by principles of free market operation – centres that offer interesting and attractive activities enjoy greater interest and attract more recipients and this usually improves their condition. Therefore, in the operation of centres, it is often possible to see selection of a strategy that is going to ensure interest on the part of visitors, as this is the determinant of “to be or not to be” of a centre. One should bear in mind that market mechanisms do not verify an important aspect from the point of view of this study – i.e. the actual utility of activities offered by the centres in science education determined by the idea and the requirements of the new curriculum. If the recipients of a centre's offer do not formulate their expectations in this respect, there are few impulses that could induce the centre, especially a commercial one, to change its strategy.

The non-formal education centres have various aspirations; however, they have a common purpose of operation: they aim for popularization of sciences or a selected area of science. Among the remaining aspirations we find specific objectives, often related to the characteristics of a centre or ideas of its founders and employees:

- arousing the pupils' interest in science, showing sciences as useful from the point of view of every-day life;
- extending and systematizing the knowledge of pupils, breaking erroneous convictions regarding the natural world;
- showing the world of nature as a complex whole, which may be looked upon from various perspectives;
- enabling pupils independent studies and experiencing of nature;
- bringing local resources of nature, culture and society closer in the context of science education.

It is worth noting that such aspirations are partially consistent with the general requirements of the NSC – this may be a signal that between the sector of non-formal education and schools there is a space for common objectives.

In relation to the educational system, the centres usually adopt one of two strategies:

- cooperation and support of schools – the centres aspire to supplement the schools' offer, they join the process of formal education and want to provide support for schools. In order to make the offer of a centre useful for schools, it has to, at least partially, form a part of the framework of formal education described by the new science curriculum – both in the context of didactic content and developed skills;
- separateness based on the contrast principle with the school – such centres most often list arousing of interest in sciences, breaking stereotypes related to – in their opinion – school teaching of sciences as their objectives; they want to attract pupils by “teaching differently than schools”; they clearly distance themselves from schools. Such centres are not interested in implementing didactic objectives of the school, but going beyond its programme and methods.

These two points of view simultaneously differentiate the approach to the NSC. For the first group, the document is an important point of reference to which they adjust their offer; for the second group of centres, the NSC is only a source of information about the level of knowledge that they can expect from pupils at a given educational stage and the scope in which their offer goes beyond the school programme. It is also worth mentioning that the text of the curriculum is little known – in order to get to know the “curriculum”, the centres usually reach for current textbooks or opinions of teachers visiting the centre. Limited familiarity with the NSC may also result in the fact that centres focus more on the teaching content contained in the curriculum and not on the teaching objectives describing complex skills. This perceptible division among centres also has another dimension – the perspective of groups of pupils supervised by teachers who visit the centres. Some of them treat the activities in the centre clearly as supplement for school education (e.g. possibility of conducting recommended experiments, making the pupils familiar with equipment, revising the material), whereas others perceive such visits solely or almost exclusively in the category of recreation (e.g. on account of exams taking place at the school). However, this is not a problem for the centres – they are usually prepared for work with both types of groups and specific groups usually determine the kind of benefits that will be drawn from the activities.

In the opinion of centre representatives, a significant group of pupils perceives sciences in a negative manner (as theoretical, difficult, boring, of limited usefulness). What is more, they believe that a large group of pupils cannot practically apply their knowledge and subsequent generations of visitors present constantly decreasing levels of scientific knowledge. Pupils with negative attitude to science, with little interest and with low skills are not easy recipients. Thence, some centres apply the strategy of offering spectacular and activating classes, which arouse interest and break negative stances. At the other edge of the continuum of stances there are pupils who are authentically interested, willing to learn and prepared for classes – work with such groups is, for the representatives of centres, a source of great satisfaction.

The benefits derived by pupils visiting the centre are often also determined by the stance of teachers who accompany them. According to the opinion of representatives of centres, many teachers attach a lot of importance to extending educational potential thanks to the centre's offer. However, certain

difficulties were noticed in cooperation between the teacher and the centre. On the basis of opinions of centre employees, it is possible to differentiate two styles of such cooperation:

- involved teacher: often cooperates closely with the centre, talks about the outline and class scenarios, promotes the centre in his/ her environment, actively participates in classes, offers support for the person conducting the activity. Thanks to such stance, the group of pupils may benefit much more than is indicated by the analysis of activity.
- withdrawn teacher: presents a reactionary stance, is not involved in cooperation with the centre, does not interfere with the course of classes, assumes the role of a viewer, not taking responsibility for the results of activities.

Among circumstances intensifying positive aspects of activities implemented in centres of non-formal education, it is necessary to indicate beneficial impact of prior preparation of pupils for activities during school classes, as well as follow-up activities after the visit at the centre. Meanwhile, according to the accounts of centre representatives, they can rarely count upon such activities on the part of teachers, which gives rise to the necessity of supplementing the activities with theoretical bases and limiting the practical part. The centres also notice that teachers – in spite of the assistance offered by the centres – e.g. in the form of worksheets, scenarios, exercises – are rarely interested in using such support during classes.

Meanwhile, employees of centres indicate that they are often devoid of any support on the part of group supervisors and list difficulties related to the conduct of activities – apart from the above-mentioned lack of pupils' preparation, there are very important aspects of preparation of employees for didactic work and the issue of authority and establishing relations with the group. The results of studies indicate that only some employees of centres are prepared to conduct classes with pupils, which is related to the fact that didactic work constitutes only a small section of their duties (e.g. scientific work). An additional difficulty is the need of adjusting the style of conducting activities for diversified recipients, also with respect to age (e.g. from preschool to upper high school pupils). The problem of authority is also indicated – or, more precisely – absence thereof: it happens that pupils behave arrogantly, impolitely and hinder the conduct of activities. Without extensive experience in didactic work, it is difficult to deal with such stances. Finally, the necessity of establishing a quick relation with the group poses difficulties, especially with respect to one-time classes – this requires interpersonal communication skills from the person conducting the activity.

The stances of the examined centres of non-formal education are diversified. There are prospering centres, procuring funds for development and investments. A relatively large group of centres does not have any problems with procuring visitors, and their agendas are full to the degree that they do not need any advertising. There were no centres that would have so few visitors that it would threaten their functioning, even though it has to be remembered that this may be caused by the strict criteria for selecting the centres for the study.

The centres perceive threats and barriers in other areas. Among most significant circumstances, it is necessary to include the unstable situation of centres – on account of structural changes or irregular legal situation and changes in the managing personnel. Problems of this type also influence the issue of procuring funds. Even though a majority of centres reach for various sources of financing, for some of them this opportunity is excluded on account of their legal form.

### **Analysis of examples of best practices**

In line with expectations, thanks to the application of defined selection criteria, it was possible to reach centres of non-formal education where examples of best practices have been diagnosed (compliant with the definition formulated for the needs of the study).

In the majority of cases, determinants conducive to best practices in centres were identified in at least two areas – i.e. in organization of a centre's operation and in implementation of activities for groups of pupils supervised by teachers. Application of selection criteria with a preference for activating methods of classes was supportive here.

In the area of organization of activities of a centre, the most important determinants conducive to occurrence of best practices are:

- adoption of purposes of operation and/ or didactic approach which are consistent with the NSC premises (development of skills in using one's own knowledge, focus on practical skills, direct experience, independence);
- linking the centre's offer with the NSC, in particular with purpose-oriented application thanks to assistance of methodological advisors (e.g. by consultation of class scenarios, didactic materials);
- adjustment of the centre's offer to the recipients' needs, active shaping of the offer with the use of evaluation results;
- skillful use of resources of the centre's environment (natural assets, social and cultural assets);
- ensuring proper servicing for activities, inter alia thanks to careful selection of persons conducting the activities, assigning a relevant number of employees necessary for efficient and safe conduct of activities.

With respect to the conduct of activities, the following determinants were distinguished which constitute elements of best practice:

- offering activities for small groups and work in small groups;
- use of activating methods (labs, observations, workshops) and mixed forms (combining direct instruction and practical methods, e.g. a seminar);
- extending the duration of activities beyond a school class or one hour;
- organization of classes into programmes and cycles;
- use of didactic materials supporting the work of pupils;
- adjustment of classes to recipients and activation of participants;
- development of skills related to scientific reasoning during classes – most often via implementation of experiments and observations and determination of cause-and-effect relations;

- creation of conditions conducive to independent and creative work of pupils;
- taking care of involvement and interest of activity participants and their earlier preparation for classes.

Referring to the definition of best practices, the results of observations of activities conducted in the examined centres and declarations of centre representatives with respect to the curriculum objectives or didactic premises, it is necessary to note that there were situations where such areas were different from each other. It sometimes happened that in spite of conducive conditions declared by the centre, there were few elements in the observed activities that could be deemed compliant with the definition of best practices adopted in the study. However, it is worth remembering that the observed activities were selected on account of premises of the study (greater chances for finding examples of best practices), and not necessarily constitute typical activities, representative for the centre. Divergences of this type have to be treated cautiously – it may happen that declarations of centre representatives refer to other, more typical and more popular activities. On the other hand, divergences may signal that representatives of centres use other criteria and other points of reference than the new curriculum to which the definition of best practices referred or that they understand the terms used in the NSC differently.

Determinants from the area of administration and financing were separated more rarely due to the fact that it is more difficult to indicate clearly their link with the definition of best practices adopted for the needs of this study. Most important – according to the report authors' – identified determinants in this area include:

- reaching for various sources of financing (including use of EU funds and local government funds, grants, funds from sponsors);
- skilful use of legal form of the centre (adequate selection of legal form or establishment of additional institutions);
- application of a flexible employment policy;
- skilful management of information about persons visiting the centre (maintenance of statistics, contact databases);
- skilful use of own resources of the centre (didactic personnel, scientific personnel, equipment, exhibits, devices).

Determinants regarding programme documents and didactic materials were encountered more rarely. In the case of programme documents, this results from the fact that in reality, few centres prepare and maintain documents that may be considered such without any doubts. The most important determinant that may be considered an element conducive to best practices is provision of programme documents with such a shape that makes it possible for stating whether the offer of the centre and, in particular, the selected classes have content compliant with purposes of education of the new curriculum for a specific subject and whether they assume development of skills related to scientific reasoning. This is supported by placement of information about the following aspects in the documents:

- subjects of activities, their general and specific objectives (in particular referring to skills and competences);

- scope of content taught during the activities;
- methods used during activities.

Rarer examples of best practices among didactic materials result from the fact that such materials were not used at every activity subject to evaluation. Also, in this case the element conducive to best practice is placement of content or instructions in the materials directly compliant with general and specific requirements of the new curriculum or conducive to development of skills related to scientific reasoning. This is supported by use of the following as materials:

- instructions for the conduct of experiments and observations, performance of measures;
- documents containing theoretical part and didactic objectives;
- documents enabling registration of the course of experiments and observations and/ or their analysis and drawing of conclusions;
- documents containing instructions enabling independent and creative work of pupils.

Among 50 centres encompassed by the quality study, we are dealing with a huge diversity of determinants conducive to best practices – there are centres where numerous valuable elements were registered, often inter-related, and there are centres which do not differ significantly, yet in some aspects also comply with the definition of best practices.

At the same time, it is necessary to remember that none of the determinants described above determines best practice in itself. It is only a certain set of determinants that may indicate that in a given area or areas we are dealing with manifestation of a best practice.

### 3. Picture of Non-Formal Science Education on a National Scale

Chapter 3 presents the picture of non-formal science education on a national scale, in the light of data obtained from the study performed by the Educational Research Institute in the 3<sup>rd</sup> quarter of 2011. This chapter uses fragments of the report from the 1<sup>st</sup> stage of study, prepared on the basis of documents and data submitted to the Contractor by the Ordering Party.

#### 3.1. Characteristics of the Population of Non-Formal Education Centres

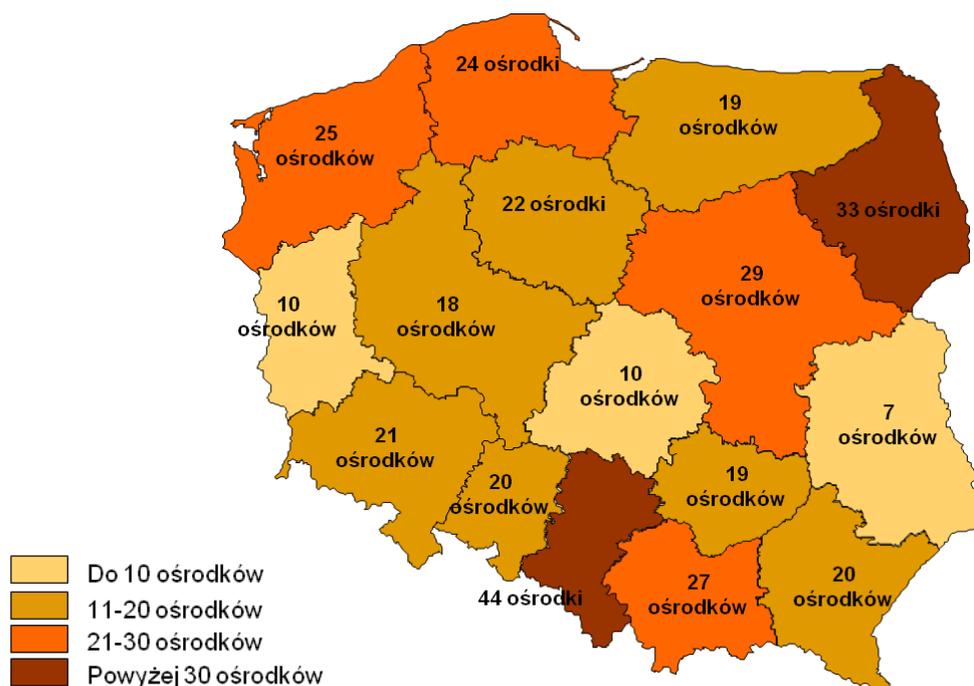
##### Data about the population

In the study, we are dealing not so much with a sample, but a population of centres where the ERI associates implemented field studies (on account of absence of reliable databases of centres of non-formal education, random choice of a sample or its purposeful selection was impossible).

Data about the number of centres where the study was conducted in individual voivodeships is presented in the picture below. The intensity of colour illustrates the number of centres in a given voivodeship in reference to other voivodeships.

Population of non-formal education centres where the study was conducted has 348 centres from 16 voivodeships. Most centres (above 30) included in the study were located in the area of the Podlasie Voivodeship (33 centres) and the Silesian Voivodeship (44 centres). Fewest centres participated in the study in the Lublin Voivodeship (7 centres) and Lubuskie Voivodeship (10 centres), as well as Łódź

**Map 2** Population of non-formal education centres where the ERI associates performed field studies in each voivodeship



Voivodeship (7 centres).

[up to 10 centres; 11 – 20 centres; 21 – 30 centres; more than 30 centres]

### Character of operation, leading body

A significant diversity was observed with respect to the nature of operation and the superior unit (or the leading body). It is worth paying attention to the fact that a significant group of centres operates next to superior institutions (e.g. universities, scientific centres, forest inspectorates):

- 79 centres are educational centres of State Forests and ecological education or nature and forest education; most facilities of this type function in the area of the Podlasie Voivodeship and then in Warmia and Mazury Voivodeship;
- 74 centres are facilities operating by universities, centres of the Polish Academy of Sciences, research centres or science centres; most facilities using the scientific resources of academic centres are located in the Masovian and Silesian Voivodeships;
- 35 facilities are national or landscape parks, whereas the remaining centres operate by non-governmental organizations, units of local government, private companies and commercial centres.

It may be assumed that domination of facilities operating by state institutions with functions different than education (in particular activities addressed to pupils from primary, middle and high schools) over independent entities and/ or private entities is related to the advantages given by the possibility of using the infrastructure, the personnel and the experience or the knowledge of superior entities.

### Range of operation

Centres with various ranges of operation function in Poland: from international to regional, as well as local ranges sometimes even limited to a city district. Almost every second centre determined its range of operation as regional on the level of a voivodeship (168 out of 348 centres), whereas every third as national (120 centres). Only 49 centres declared that they operate internationally (including as many as 11 centres from the Silesian Voivodeship).

A definite majority, i.e. 255 out of 348 centres showed only one level of operation – which means, with respect to the information provided above, that majority of facilities do not go beyond the borders of a voivodeship with their offer. It is particularly necessary to mention centres from the Podlasie Voivodeship and Warmia and Mazury Voivodeship, whose declarations testify to the fact that such facilities, in a definite majority, do not focus on national or international recipients (in the Podlasie Voivodeship 23 out of 33 centres declared regional range below the level of the voivodeship, whereas in Warmia and Mazury, such declaration was provided by 15 out of 19 centres). Centres with national range were listed most often in the Opole Voivodeship (15 out of 20), Masovia (12 out of 29), Świętokrzyskie (11 out of 19) and Pomerania (10 out of 24). Facilities with range of operation on the level of a voivodeship were also frequently listed in the area of the Świętokrzyskie and Opole Voivodeships.

### **Financing classes for groups of pupils supervised by teachers**

In the financing of activities by centres of non-formal education, the practice of using own funds was dominant (266 out of 348 centres), as well as local government funds (121 out of 348 centres, probably mainly these that operate by the units of local government). Procurement of EU funds (79 centres) or procurement of sponsors (75 centres) was less frequent. It is also possible to assume that few facilities reach for diversified funds.

On the basis of the observations that were made, it may be noted that various sources of financing are observed in these voivodeships where the share of centres financing activities from own funds is relatively smaller (e.g. the Lublin or the Silesian Voivodeship) in comparison to voivodeships where conduct of activities mainly relies on own funds (e.g. Świętokrzyskie Voivodeship, Podkarpackie Voivodeship). This may suggest that motivation for searching for various sources of financing is the deficit of own funds in the centre and not, for example, willingness to invest or to expand operation. On the other hand, a different hypothesis may be proposed – reaching for funds other than own depends on the activity and entrepreneurship, and also on the knowledge and substantive preparation of persons and organizations within the scope of using funds other than local government or budget funds. The quality study also indicates that operation and skills regarding applications for additional funds are decisive for successes of centres in this field. However, this does not offer a basis for verifying the thesis that the deficit of funds motivates the centres to search for external sources of financing more than a drive to investments. In many cases these elements are inter-related and the impossibility of investments and development of a centre blocks the possibilities of procuring funds for implementation of new and ongoing educational programmes.

### **Payment for activities**

It is interesting to note that a large part of centres finance the conducted activities from own funds – as many as 255 out of 348 facilities (65%) declare that their classes are free-of-charge for the recipients; in 54 centres the activities are partially payable. 130 centres declare that they collect fees for participation in activities (37%). Free-of-charge offer is the most popular in the area of Podkarpackie and Warmia and Mazury Voivodeships, where free-of-charge activities are offered by all examined centres. Most free-of-charge activities were registered in the area of the Lesser Poland Voivodeship and, subsequently, in the Silesian Voivodeship, Masovia, Pomerania and Greater Poland.

### **Repeatability of activities from the centre's offer**

The organizational aspect of the offer of centres is also characterized by repeatability. Centres are, in a definite majority, oriented towards repetitive activities – continuous (174 out of 348 centres) or cyclical (133 out of 348 centres). On the one hand, this probably facilitates organization of activities and on the other depreciates certain costs related to launching such activities (e.g. preparation of a programme, training of personnel, organization of equipment, materials, etc.). Most often, continuous activities are offered in the Silesian Voivodeship, whereas they do not occur in the offer of any centre in the area of the Opole Voivodeship.

### 3.2. Didactic and Methodological Aspects of the Offer of Science Activities for Groups of Pupils Supervised by Teachers

When analyzing the didactic aspect of the offer of centres participating in the study, data regarding the supported teaching subject was taken into account, as well as documents constituting a substantive and methodological basis for the implemented activities and their methodological nature.

#### Teaching subjects

Among subjects supported by activities, science is clearly dominant (306 out of 348 centres) along with biology (292 centres), as well as geography (205 centres). It is possible that activities related to science, biology or geography are easier and cheaper to organize than activities related to physics (102 centres) or chemistry (117 centres). It is also possible to put forward a hypothesis that the profile of the centre's offer with respect to science, biology or geography does not deprive the facility of certain universality (and possibilities of quicker reaction to demand on the part of recipients), whereas the physical or chemical profile is not only more costly, but also more specialized and requiring greater organizational effort. The quality study partially confirms such hypotheses. It clearly indicates that in order to offer activities that are interesting and go beyond the potential of a school, the centres attempt to make specialist facilities and didactic aids available to pupils. In particular, in the case of physics, chemistry and related subjects (e.g. biochemistry), this requires greater outlays of funds and time, as well as provision of specialists who can use them.

Territorial distribution of centres supporting the teaching of physics and chemistry is unequal. Definitely more proposals in the area of chemistry are found in the area of the Pomerania Voivodeship (21 facilities); they are also relatively numerous in the area of Lesser Poland (12), Masovia (11), Kujawy and Pomerania (10), Lower Silesia (10) and Silesia (10). No proposal was recorded in the area of the Opole Voivodeship and only one in the Lublin Voivodeship.

Taking into account the distribution of proposals addressed to physics teachers, it is possible to state that teachers receive greatest support in the area of the Pomerania Voivodeship (16), Silesia (16), Masovia (15), Lesser Poland (13) and Kujawy and Pomerania (10). It is necessary to note the fact that no proposal was recorded in the area of the Lublin Voivodeship and only one in the area of the Opole Voivodeship.

According to the collected data, the most diversified offer taking into account all science subjects may be found in the area of Lower Silesia and Pomerania. On the other hand, least diversified subjects were recorded in the area of Opole and Lublin Voivodeships.

#### Documents Constituting Substantive and Methodological Basis for Performed Activities

A definite majority of centres conduct science activities on the basis of their own programme (301 out of 348 centres), whereas 69 facilities indicated that during organization of activities they relied on the curriculum prepared by the Ministry of National Education. However, it is worth remembering that centres are not required to take into account the NSC in their operation; this does not exclude the fact that the manner of conducting activities in such centres is consistent with their postulates.

Territorial distribution of centres declaring the use of the curriculum is diversified. Most centres were recorded in the area of the Silesian Voivodeship (14), whereas no centres that rely on the curriculum

were recorded in the area of Podkarpackie Voivodeship, Western Pomerania Voivodeship; in Lublin, Opole and Świętokrzyskie Voivodeships there were only individual cases of such centres.

The syllabus, as the basis of the didactic offer, was indicated least frequently in the centres.

### **Methods of conducting activities**

The centres offer a broad range of methods for conducting activities – the catalogue includes both direct instruction methods (lecture, showing a museum exhibition), as well as methods potentially supporting the teaching of skills (workshops, labs). Among all offered methods of activities, lectures (295 out of 348 centres) and workshops (273 centres) are encountered almost on the same level; as well as field trips (193 centres) and visiting a museum exhibition (161 centres).

Among dominant methods, workshops (107 centres) and field trips (89 centres) were most popular. In 81 centres, lectures were dominant for science activities.

In the area of individual voivodeships, the methodological nature of the offer is diversified. Most frequently, instruction methods are dominant; subsequently, there are workshops. The most diversified offer, i.e. a full catalogue of methods and relatively slight variation of their indications may be observed in the area of Masovia.

### **Materials and didactic aids for participants of activities**

Centres of non-formal education declare that they provide their recipients with didactic materials in the course of activities – 95 centres always provide materials, whereas 141 centres do that sometimes or in the case of only some classes. However, the character and the quality of materials may be much diversified – among listed materials and aids, there are both these that potentially support the shaping of skills (laboratory devices, equipment for activities in the field, worksheets, natural specimens, etc.) and such that do not exert such impact (books, textbooks, guidebooks, folders, source texts, written and graphic materials).

Most often, “didactic materials” constitute simply books, textbooks and folders (164 centres) or worksheets (137 centres). However, as many as 76 facilities also consider written and graphic materials (e.g. crayons and paper for drawing for youngest pupils) didactic materials. This data indicates the need of approaching the declaration of centres cautiously with respect to evaluating the degree in which their operation complies with the definition of best practice in non-formal science education. Children and young people can rarely count upon materials and didactic aids with respect to which a hypothesis was put forward that they may support the teaching of scientific thinking most efficiently, therefore such as equipment for laboratory classes, e.g. magnifying glasses or microscopes or equipment for field trips, such as, e.g. nets for insects, binoculars or keys for marking organisms. The nature of offered materials is also related to the methodological offer of activities and, in relation to this, it is difficult to draw explicit conclusions about their territorial distribution.

## 4. Best Practices Conducive To Didactics Shaping and Developing Skills Related to Scientific Reasoning

Diagnosis of examples of best practices within the scope of science activities implemented by centres of non-formal education constituted the main purpose of the study. Let us remind you that the adopted research model assumed searching for, in the visited centres, elements compliant with the definition of best practices, i.e. **“activities and determinants related to them (institutional, organizational and financial), which:**

- **allow for formulation of research procedures and testing them (planning and performance of experiments, observations) within a scope described in teaching objectives and recommended experiments and observations of the new science curriculum;**
- **refer to skills important in science education – related to scientific reasoning, such as: planning and performance of experiments and observations, formulation of conclusions, determination of cause-and-effect relations, differentiating between opinions and facts and supporting own stances with tangible arguments, described in the teaching objectives of the new science curriculum.”**

For the purpose of systematizing the analysis – both on the level of individual centres and on the level of all centres – four areas were determined, where examples at least partially complying with the adopted definition were indicated. Areas of analysis included:

1. **Administration and financing:** this area includes determinants related to management of the centre’s operations, interesting administrative and organizational solutions and solutions within the scope of financing the centre’s operation and activities;
2. **Organization of the centre’s activities:** this area includes determinants related to the objectives of operations, premises and educational approach, linking the centre’s offer with the new science curriculum, relations of the centre with broadly understood environment (both natural, social and institutional) and servicing of activities;
3. **Performance of activities:** this area includes determinants closely related to implementation of activities for groups of pupils supervised by teachers, resulting both from accounts of employees of the centre and from accounts regarding the two observed activities derived from an observer and participants and teachers accompanying the groups;
4. **Didactic and programme materials:** this area includes determinants related to programme documents constituting a basis for the performed activities (programmes, syllabuses) and didactic materials used during the observed activities.

However, it is necessary to emphasise that the adopted division has only an agreed upon nature – in reality, such areas are inter-connected and pervade each other. In many cases, direct location of a given determinant is not explicit.

It is also worth noting that individual determinants do not determine best practice in itself; only occurrence of such determinants in certain groups, in positive couplings may indicate the fact that a given centre is an example of best practices. Such examples are to be considered solely in reference to general requirements, i.e. purposes of teaching of the new science curriculum and skills related to scientific reasoning.

In the study below – which is some sort of a catalogue of diagnosed elements of best practices – there are examples of centres where a given determinant or a solution was noticed (they appear in brackets). Comprehensive information about best practices diagnosed in centres was collected in the table at the end of the chapter. More detailed information about all of the collected determinants is placed in descriptions of individual centres in the second part of this report. The key information allowing for finding a given example is the number and the name of the centre – also presented in the text, the table and in descriptions of centres as identifiers.

## 4.1. Area 1: Administration and Financing

### Financing of educational activity

Solutions and determinants from the area of financing the educational operations seem to be the most important aspect of the first area.

Determinants conducive to occurrence of best practices in a centre include **procurement of various sources of financing**. Additional funds are used for various purposes – among them, particularly important from the point of view of the best practice criterion are exemptions from or decreases of fees for activities and purchase of equipment, devices or materials. Such activities influence availability of activities and may improve their quality. From the point of view of commonly available education, it is important to reduce the cost of activities for the participants in order to allow the less affluent group of pupils participate in the activities. Some centres offer free-of-charge activities for all participants (e.g. 508 Landscape Park of Łódź Hills, 115 Green School in Schodno, 1211 Moravia Gate Arboretum in Racibórz) or for selected groups, e.g. from the area of specific communes within the scope of contracts with local administration (e.g. 1114 the Gdynia Aquarium) – unfortunately, some centres are not able to offer free-of-charge classes due to absence of other sources of financing their educational operation. However, an example of a flexible approach to fees for activities has appeared – lowering or exemption from payment for individual pupils or entire groups (e.g. 102 “Planetarium” Astronomy Didactics and Popularization Division, 1225 Physics Didactics Division of the University of Silesia). Some centres additionally increase the availability of their activities by providing or co-financing transport of pupils to a centre (e.g. 1110 Gniezno Centre of Ecological Education by the Active Centre Association in Gniezno).

A number of determinants are related to the use of external sources of financing the educational activity, some of which may additionally be conducive to occurrence of best practices. First of all, it is necessary to bear in mind that **the potential of using various sources of financing is strictly related to the legal form of a centre and its dependence on superior institutions**.

Among the most important and most frequently occurring sources of financing of educational activity in the centres of non-formal education, it is necessary to include:

- **own funds:** deriving from fees for activities or admission to the centre (e.g. 209 Zoobotanical Garden in Toruń, 307 Nature Museum, Sub-Division of the Vistula Museum), from economic

activity performed by the centre (e.g. 1219 Ecological Education Centre Representative Bison Pen, 211 Forest School in Barbarka);

- **funds from units of local government:** provided to centres which are units subordinate to local governments (e.g. museums, zoological gardens – a good example is this respect is centre 113 ZOO in Wrocław), but also independent institutions, performing tasks commissioned within the scope of educational projects for children and young people from a given area (here, a good example is provided by centre 1104 Eco-Initiative Association in Kwidzyn);
- **European Union funds:** most often, the following entities are listed in this context: Voivodeship Fund for Environmental Protection and Water Management (VFEPWM) and the National Fund for Environmental Protection and Water Management (NFEPWM) (used by, e.g., centres 1104 Eco-Initiative Association in Kwidzyn, 1004 Wigry Museum of Alfred Litiński – Wigry National Park).

Much less frequently, there are such sources of financing as **funds from sponsors** (e.g. 703 BioCEN BioCentre for Science Education), funds from institutions co-creating a centre, funds deriving from **grants** (e.g. 606 Municipal Engineering Museum in Cracow).

It is also worth mentioning, in the context of sources of financing, that use of some of them imposes certain obligations on the centre, which may also be interpreted in the categories of encouragement for best practices and which will be discussed in a further part of the study – here, we can talk about requirements for evaluation the activities (requirement for projects co-financed by the EU – e.g. 1219 Ecological Education Centre Representative Bison Pen) and an obligation of maintaining statistics of visitors and participants of activities (requirement of local government units).

More detailed information about funds procured by centres is contained in Chapter 5 of this report.

### Organizational solutions

A very important factor influencing the possibility of procuring various funds, independence in the shaping of offer or management of resources is **the legal form of a centre**. Even though in the majority of cases, it is difficult to speak about a conscious or purposeful selection of a legal form – it may be in the hands of the founding authority (e.g. a commune or a city), yet centres having problems related to unclear and unstable legal situation sometimes reach for solutions consisting in **establishment of an additional institution** – e.g. **in the form of an association or a foundation** which, not being encumbered by limitations of the mother-centre, may apply for EU funds, subsidies or conduct non-profit activity more easily and efficiently (e.g. centre 201 Kujawy and Pomerania Centre of Ecological Education in Bydgoszcz, centre 703 BioCEN BioCentre for Science Education). Such activities may be considered an element of best practice due to the fact that they are conducive to stabilizing the centre's situation and increase its potential within the scope of searching for various sources of financing.

With respect to internal solutions conducive to occurrence of best practices, it is worth mentioning **separation of additional structures** (especially in larger institutions) – divisions, offices and workshops which focus on tasks related to didactics (e.g. centre 712 National Centre for Nuclear Research in Świerk, 113 ZOO in Wrocław). Thanks to this, the didactic offer may be more consistent and better adjusted to the needs of the recipients, i.e. groups of pupils supervised by teachers.

Moreover, among interesting organizational solutions, it is possible to list **application of flexible employment policy** by establishing cooperation with people who are not regular employees of centres, but cooperate with them periodically (e.g. in the summer season) or sporadically (upon commission). Such persons are employed on the basis of commission contracts or contracts for specific work, which is related to smaller financial and administrative burden for a centre (solutions of this type were noticed in, e.g., centre 1219 Ecological Education Centre Representative Bison Pen, 113 ZOO in Wrocław) and, at the same time, allow for enriching and varying the didactic offer.

### Managing information about visitors

Among solutions which facilitate management of a centre and adjustment of the offer to the needs of the recipients, it is possible to indicate **maintenance of visitors' statistics**. Statistics of this type are maintained on various scales – sometimes, they are very precise (e.g. centre 113 ZOO in Wrocław), in other cases general (e.g. 107 “Planetarium” Astronomy Didactics and Popularization Division). Sometimes, statistics are maintained for reporting purposes – a centre has to account for them to the superior unit.

Apart from distinguishing attractive and little popular elements of the offer, the visitors' statistics may be used by centres when writing applications for EU subsidies or during participation in various competitions (e.g. 1001 Centre for Science Education of the Białowieża National Park, 501 “Źródła” Centre for Ecological Activities).

In the context of a centre's management, maintenance of various types of **contact bases**, lists of schools, groups or **group supervisors who visit the centre** is very useful on account of maintaining contact (e.g. centre 216 Small Scale Chemistry Centre, Chemistry Didactics Division, Chemistry Faculty of the Nicolaus Copernicus University in Toruń). This is valuable both from the point of view of informing about the centre's offer and its changes, as well as the possibility of procuring information about the teachers' need for specific activities or opinions about already performed activities.

### Use of the centre's resources

In the area of administration, activities related to **efficient use of back-up facilities** at the disposal of a centre or its superior institution seem to be important. This refers to human resources (didactic and scientific personnel) (e.g. 102 “Planetarium” Astronomy Didactics and Popularization Division), as well as facilities, equipment, exhibits or devices for performance of activities (good examples in this respect are provided by 703 BioCEN Biocentre for Science Education, 712 National Centre for Nuclear Research in Świerk and 4062 Nature Museum of the Faculty of Biological Sciences of the Zielona Góra University).

## 4.2. Area 2: Organization of Centre's Operation

### Purposes of operation of a centre and didactic approach

A condition conducive to occurrence of elements of best practices in the centres is **determination of purposes of operation of a centre or the didactic approach applied there** in a manner that refers to skills important in science education, **related to scientific reasoning**, as well as indicates the consistency of activities undertaken by it with the NSC teaching objectives.

Among purposes and assumptions conducive to best practices, it is possible to indicate several interesting examples:

- declaration of **support for schools in the process of science education** (e.g. 201 Kujawy and Pomerania Centre of Ecological Education in Bydgoszcz, 505 Centre for Ecological Education “In the Łagiewniki Forest”, 1225 Physics Didactics Division – University of Silesia, 725 Physics Workshop at the Faculty of Physics at the Warsaw University);
- support for pupils **in development of skills related to the use of their own knowledge** (e.g. 606 Municipal Engineering Museum in Cracow);
- emphasis on getting to know science **via direct experiments** (e.g. 1211 Moravia Gate Arboretum in Racibórz, 1220 Upper Silesian Museum in Bytom);
- encouragement for **drawing independent conclusions, breaking of stereotypes** (e.g. 712 National Centre for Nuclear Research in Świerk);
- enabling **independent performance of experiments and observations** (e.g. 4062 Science Museum of the Faculty of Biological Sciences of the Zielona Góra University, 1004 Wigry Museum of Alfred Litiński – the Wigry National Park, 725 Physics Workshop at the Faculty of Physics at the Warsaw University);
- **promotion of sciences** among children and young people, encouraging children and young people to become interested in them (e.g. 102 “Planetarium” Astronomy Didactics and Popularization Division).

### Shaping of the centres' offer

With respect to the shaping of offer of centres of non-formal education, several solutions were noticed which are conducive to occurrence of best practices:

- **exchange of experiments and materials with other centres** of non-formal science education (e.g. 201 Kujawy and Pomerania Centre of Ecological Education in Bydgoszcz), **cooperation during preparation of programmes** and didactic materials (e.g. cooperation between 1219 Ecological Education Centre Representative Bison Pen in Pszczyna and 1001 Centre for Science Education of the Białowieża National Park), **use of didactic base of other centres, inviting teachers** (e.g. 1228 Biology Didactics Division of the University of Silesia – “Kuznia” Culture and Sports Association);
- **adjustment of subjects** and scenarios **to the needs of specific recipients**, performance of activities upon **individual order** of schools (e.g. 216 Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry at the Nicolaus Copernicus University in Toruń, 1004 Wigry Museum of Alfred Litiński – the Wigry National Park, 1225 Physics Didactics Division – University of Silesia, 725 Physics Workshop at the Faculty of Physics of the Warsaw University);
- taking care of **offer variety**, dynamic shaping of the offer (change in the set of subjects), e.g. 113 ZOO in Wrocław, 216 Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry at the Nicolaus Copernicus University in Toruń);
- **extensive range of subjects** (e.g. 113 ZOO in Wrocław), **various forms of activities** (e.g. 4062 Nature Museum of the Faculty of Biological Sciences at the Zielona Góra University);

- **evaluation** of activities for the purpose of improving the offer and the manner of conduct of activities (e.g. 505 “In the Łagiewniki Forest” Centre of Ecological Education, 1104 Eco-Initiative Association Kwidzyn). Sometimes, the evaluation refers to the newly introduced subjects (e.g. 113 ZOO in Wrocław);
- **supplementing science education** with other forms of activity enabling promotion of sciences, increasing their attractiveness, getting to know the world holistically, in various aspects – e.g. promoting ecology via art (201 Kujawy and Pomerania Centre of Ecological Education in Bydgoszcz, 4062 Nature Museum of the Faculty of Biological Sciences at the Zielona Góra University), organization of competitions for pupils, events or educational activities (e.g. 712 National Centre for Nuclear Research in Świerk, 1101 Centre for Ecological Information and Education in Gdańsk, 920 Chamber of Forest Education, Jarosław Forest Inspectorate).

### Relating the centre’s offer to the NSC

The closer and clearer the relation of the centre’s offer with the NSC, the more it is possible to talk about compliance with best practice criteria in line with the definition adopted in the study. Meanwhile, the study revealed the entire range of centre stances with respect to the curriculum, only some of which may be deemed elements of best practices and determinants conducive to occurrence of best practices. Chapter 5 of this report discusses the centre stances with respect to the NSC in more detail.

Without doubt, an element of best practices is a situation where a centre **purposefully adjusts its offer to the general requirements of the NSC**. Sometimes, this is done independently by employees of the centre (e.g. 216 Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry of the Nicolaus Copernicus University, 725 Physics Workshop at the Faculty of Physics at the Warsaw University) or in consultation with teachers; sometimes, the assistance of methodologists is also used (e.g. 107 Environmental Education Centre in Krośnice, 1219 Ecological Education Centre Representative Bison Pen in Pszczyna, 1004 Wigry Museum of Alfred Litiński – the Wigry National Park).

An intermediate solution which is conducive to the occurrence of best practices is a situation where the **NSC is the point of reference for the offer’s authors** – they reach for the document in order to find out about skills and the extent of knowledge presented by pupils at a given educational stage and to become familiar with the didactic content, e.g. the required experiments (e.g. 4062 Nature Museum of the Faculty of Biological Sciences at the Zielona Góra University), 703 BioCEN Biocentre for Science Education). The study results testify to the fact that the centres are more focused on the scope of material – content of teaching and not on skills. On account of limited familiarity with the content of the NSC among representatives of centres, it may be assumed that some of them are not aware at all that the curriculum contains requirements regarding developed skills. It follows from the talks with centre representatives that they sometimes believe that activities in the centre – in contrast to a school – help develop skills related to scientific reasoning and that this was own idea of a centre.

### Relations of a centre with institutional, social, cultural and natural environment

A determinant conducive to occurrence of best practices is **maintenance by a centre of close relations with the school environment** – contacts with teachers, participation in methodological and educational conferences, cooperation with methodologists, etc. (e.g. 107 Environmental Education Centre in Krośnice). Relations of this type allow for better understanding of needs to which the centre’s offer is an answer.

Definitely, organization of activities compliant with the best practice definition is also influenced by **skillful use of the resources in the immediate environment:**

- **natural resources:** attractive location of a centre allows for using the natural values of the environment for the conduct of more interesting and better activities (e.g. 201 Kujawy and Pomerania Ecological Education Centre in Bydgoszcz);
- **social and cultural resources:** connecting the centre's operation with the life of a local community is conducive to protection of nature and cultural assets, as well as development of skills in pupils (e.g. 107 Environmental Education Centre in Krośnice).

### Servicing of activities

Determinants conducive to occurrence of best practices with respect to the servicing of activities refer to three aspects:

- ensuring **proper servicing for activities** – personnel necessary to make the activities run smoothly and safely (e.g. 712 National Centre for Nuclear Research in Świerk, 4062 Nature Museum of the Faculty of Biological Sciences at the Zielona Góra University). Obviously, it depends on the character and the subject of activities what type of servicing is sufficient – with respect to laboratory classes, this may mean that every team is assigned a supervisor; with respect to less demanding microscope activities, an assistant's help for the person conducting the activity may be sufficient;
- use of **volunteers** e.g. students (4062 Nature Museum of the Faculty of Biological Sciences of the Zielona Góra University);
- **selection of persons conducting the activities in line with their interests and passions** (e.g. 102 "Planetarium" Astronomy Didactics and Popularization Division, 113 ZOO in Wrocław, 209 Zoobotanical Garden in Toruń, 4062 Nature Museum of the Faculty of Biological Sciences of the Zielona Góra University, 723 Technology Museum in Warsaw) has a clear beneficial impact on the quality of activities and the degree of the participants' involvement.

## 4.3. Area 3: Performance of Activities

Definition of best practices refers, in a largest degree, to the activities implemented in the centre, the content transmitted in the course of activities and the skills related to scientific reasoning. Before the commencement of 2<sup>nd</sup> stage of the study, it was assumed that specific methods and forms of work are conducive to the shaping of scientific reasoning; they are described by the teaching objectives of the NSC – this assumption was the basis for the criteria for selection of centres to the quality studies.

Below, several determinants that may be conducive to occurrence of best practices within the scope of implementation of activities are listed:

### Characteristics of activities

- **small groups** (e.g. 216 Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry of the Nicolaus Copernicus University, Toruń, 703 BioCEN Biocentre for Science Education, 1212 Coal Mining Museum in Zabrze, 725 Physics Workshop at the Faculty of

Physics at the University of Warsaw) – both in the sense of limiting the number of pupils in the group, as in the sense of small working groups, formed during the activities. Work with small groups is conducive to greater independence of pupils and possibilities of direct involvement in classes. Small groups are more disciplined; they are less bored (because there is a task for everybody). In small groups, the teacher may devote attention to every pupil. Pupils in small groups have a greater possibility for active development of skills related to scientific reasoning, whereas in large groups, such potential exists only for some of the participants;

- **methods and forms of conducting activities.** It is worth remembering that the source of criteria for the ranking of centres in the second stage of the study was an assumption that activating and practical methods are conducive to compliance with best practice conditions.
  - **laboratory activities** – performance of experiments, usually according to oral or written instructions (e.g. 703 BioCEN BioCentre for Science Education, 216 Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry at the Nicolaus Copernicus University in Toruń, 1225 Physics Didactics Division – University of Silesia);
  - **observations** – micro and macroscopic observations (201 Kujawy and Pomerania Centre for Ecological Education in Bydgoszcz), observations of nature in the field (e.g. 1211 Moravia Gate Arboretum in Racibórz, 107 Environmental Education Centre in Krośnice, 505 Ecological Education Centre “In the Łagiewniki Forest”), usually conducted according to oral or written instruction;
  - **workshops** – practical activities, within the scope of which activity participants act together – in small groups or in teams; they solve problems and draw conclusions; they may refer to the conduct of experiments, but also other types of activities, e.g. constructing of sets necessary for the conduct of experiments (e.g. 712 National Centre for Nuclear Research in Świerk), but also machines, devices (e.g. 606 Municipal Engineering Museum in Cracow).

In this context, it is worth noting that **mixed forms** also contributed to compliance with the best practice criteria, i.e. forms combining elements of direct instruction and practical methods. Thanks to such design of activities, the participants got a chance to get to know the theory (in the form of a lecture or an instructing talk) before doing practical activities, and after their completion, they could solidify their knowledge thanks to the summary of activities (in various instructive forms – a lecture, a presentation, or problem related – a discussion). This is particularly important in the context of results of the quality study, where representatives of centres show that young people come to the class without prior preparation and basic knowledge – thence, such theoretical introduction is frequently simply necessary. Interesting examples are activities observed in centre 1104 Eco-Initiative Association, Kwidzyn (within the scope of programme “Nature Researchers’ Forge”) or day-long **research seminars** observed in centre 712 National Centre for Nuclear Research in Świerk.

- **extending the time** beyond duration of a school lesson. The premises for selection of activities for observation included guidelines to make the observed activity last 45-60 minutes, thence approx. one school lesson. However, centres offered longer didactic blocks: 90-120 minutes, 2 – 4 hours, sometimes day-long, divided into modules, implemented with the use of various methods. Extension of the duration of classes (taking into account breaks necessary for relaxation) resulted in the fact that it was possible to do more in the course of them –

conduct longer experiments (or more experiments) and observations, supplement the activities with a theoretical introduction or summarize them in the form of a discussion. Longer duration of activities entails, primarily, more opportunities for developing skills related to scientific reasoning – the possibility of perfecting a given skill or a possibility of developing multiple skills within the scope of one activity. For example, thanks to extending the duration of classes, there was sufficient time not only for implementation of an experiment, but also for registering its results, formulation of conclusions, presentation and discussion in the course of which there was an opportunity for supporting one's stance with material arguments;

- **organization of activities into programmes or blocks.** Some centres offer activities forming a part of specific cycles or programmes – e.g. organized every week or every month. This solution is conducive to best practices in a manner similar to extension of duration of individual activities – in a cycle, it is possible to extend the subject, to continue a subject from previous activity, to refer to previously shaped skills or already acquired information, etc. What is more, cyclical meetings influence greater involvement of the group and more friendly atmosphere during activities – the persons conducting the activities and the participants have an opportunity of getting to know each other better and become integrated thanks to which they feel more at ease and work goes more smoothly (e.g. 216 Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry of the Nicolaus Copernicus University in Toruń, 725 Physics Workshop at the Faculty of Physics at the Warsaw University).
- **use of “every-day” materials.** Conduct of activities with the use of simple, generally available materials or aids and with small financial outlays increases the attractiveness of presentation of a subject (606 Municipal Engineering Museum in Cracow). What is more, it brings sciences closer to every-day life, thanks to which the participants of activities may notice the manner in which science is present in their life, how to use the knowledge acquired during activities, etc. (216 Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry at the Nicolaus Copernicus University in Toruń);
- **use of didactic materials supporting the work of pupils.** Good quality didactic materials may be conducive to development of skills related to scientific reasoning. Use of written instructions in the course of activities, worksheets, exercise books, tables, atlases, etc. allow for development of a skill of using various sources of information, recording the results of observations and experiments, solidification of acquired knowledge (e.g. 216 Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry at the Nicolaus Copernicus University in Toruń, 725 Warsaw University, Faculty of Physics, 703 BioCEN Biocentre for Science Education, 1104 Eco-Initiative Association, Kwidzyn, 712 National Centre for Nuclear Research in Świerk, 1219 Centre of Ecological Education Representative Bison Pen). The content of didactic materials used in the course of activities will be discussed in the following sub-chapter;
- **adjustment of activities to recipients.** Activities whose manner of conduct, their thematic scope and course were adjusted to the recipients met with approval of the observers and participants. This refers not only to the educational stage or the age of pupils, but primarily to their earlier preparation (or its lack), perception potential, taking care whether they really understood everything. Adequacy in selecting the manner of conducting activities to the recipients may be concluded primarily on the basis of questionnaires for teachers and pupils where they express their satisfaction with adjustment of the course of activities to participants

and declare that the content that was taught was fully understandable (e.g. 1104 Eco-Initiative Association, Kwidzyn, 1211 Moravia Gate Arboretum in Racibórz);

- **activating the group.** The observed activities clearly differed with respect to activation of groups of participants (which was also partially related to the size of groups, preparation and interest of pupils in activities). The activities in the course of which the instructors made sure that all pupils participated actively in observations, experiments and tasks, responded to questions or asked questions were deemed compliant with the best practice definition. Thanks to this, all participants had an opportunity for developing skills shaped in the course of the activities, related to scientific reasoning (e.g. 201 Kujawy and Pomerania Centre of Ecological Education in Bydgoszcz, 216 Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry of the Nicolaus Copernicus University in Toruń, 4062 Nature Museum of the Faculty of Biological Sciences of the Zielona Góra University).

### Compliance of observed activities with the best practice definition

A condition necessary for compliance with the best practice definition is consistency of activities with the NSC teaching objectives. **In the majority of cases, during the observed activities it was possible to discover tasks and content consistent with the teaching objectives of the NSC, conducive to their implementation**, even though in certain cases these were individual activities and in other cases their entire ranges.

It is worth remembering that in the case of this criterion, “more” does not mean “better” – some activities focused only on a specific general requirement (e.g. improvement of work with a microscope, in the case of biology – 201 Kujawy and Pomerania Centre of Ecological Education in Bydgoszcz, improvement of practical activities related to laboratory equipment in the case of chemistry – 1104 Eco-Initiative Association, Kwidzyn), whereas others combined many requirements (e.g. conduct of physical experiments, use of physical dimensions for their description and indicating examples of phenomena in the surrounding reality in the case of physics – 725 Warsaw University, Faculty of Physics).

When referring to the definition of best practices, the results of observations of activities conducted in the examined centres, it is necessary to notice that the skill developed most frequently during the observed activities was **performance of experiments and observations**. It is also necessary to mention that there were cases where activities did not contain any other elements, even though there was relevant space. Among skills frequently developed during activities, it is also possible to indicate **determination of cause-and-effect** relations; however, this was rarely conducted independently by pupils and more often during an instructive talk.

Experimental and laboratory classes aimed at improvement of the **conclusion formulation** skill were encountered relatively less frequently. Similarly to determination of cause-and-effect relations, it was more often the person conducting the activity who formulated the conclusions and summarized experiments or observations in the form of a talk or a moderated discussion.

It is also necessary to note that the most infrequently developed skills included skills closely related to independent, critical thinking – i.e. **differentiating opinions from facts** and **supporting own stance with substantive arguments**. What is more, even if such skills were developed, it took place at further educational stages (primarily the 4<sup>th</sup> stage).

However, it has to be emphasized that absence of elements such as drawing conclusions or presenting arguments may be partially related to the selection of activities. Adopting the assumption about selection of 45 – 60 minute activities for observation may have resulted in the fact that the observers simply missed longer activities, where there was place for conclusions, discussion of results, etc. On the other hand, it is also possible that such longer activities conducted by such centres are devoid of such elements. In the context of developing skills important in scientific reasoning, it is also worth mentioning **support for independent work of pupils** and **creative work of pupils**. Both these circumstances create beneficial conditions for development of skills important in science education. Within the scope of the observed activities, conditions for independent work of pupils were created much more often – e.g. during the conduct of experiments or observations according to the instruction (e.g. 216 Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry of the Nicolaus Copernicus University, Toruń, 505 Ecological Education Centre “In the Łagiewniki Forest”). Conditions for creative work occurred much less frequently (e.g. 4062 Nature Museum of the Faculty of Biological Sciences of the Zielona Góra University, 712 National Centre for Nuclear Research in Świerk), probably on account of limited time of activities and focus on meeting specific didactic objectives.

### Stances of participants

Finally, a determinant having significant impact on the fact whether the activities may be deemed conducive to occurrence of best practices and which constitute an element slightly dependant on the centre is the **involved stance of the participants of activities**, their interest in the subject and willingness to participate in the activity, as well as **prior preparation of pupils for activities**.

The study results clearly indicate that without the pupils' involvement, it is more difficult to conduct classes which would be conducive to occurrence of best practices. On the level of analysis of results of questionnaires completed by pupils, it was ascertained that activities attended by young people interested in the subject, having positive motivation to participate, scored better in the context of the best practice definition (e.g. 1104 Eco-Initiative Association, Kwidzyn, 725 Physics Workshop at the Faculty of Physics of the Warsaw University). Such factors obviously influence other determinants – the possibility and the willingness to work independently or creatively, possibility to activate the participants, possibility to implement the assumed didactic objectives, etc.

On the other hand, prior preparation of pupils for activities, e.g. within the scope of classes at school or prior activities in the centre, results in the fact that more time may be devoted to implementation of didactic purposes, development of skills related to scientific reasoning instead of supplementing the gaps. Good effects of such practice may be noticed in, e.g., centre 216 Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry at the Nicolaus Copernicus University in Toruń.

It is worth noticing that a strategy adopted by some centres consisting in offering of activities organized into programmes or cycle is intended to increase the probability of the fact that activity participants will include interested, involved or previously prepared persons.

## 4.4. Area 4: Didactic Materials and Programme Documents

### 4.4.1. Programme Documents of the Centre

Centre representatives provided various documents and materials as programme documents. It is necessary to note that many of such documents had, in this context, debatable nature – the centres

provided posters, folders, book publications, fragments of applications for co-financing, educational packages, multimedia materials, etc. Due to this, before final analyses compliant with the study premises, it was necessary to select and exclude from analyses some of the submitted materials.

**In spite of a crystallized concept of operation of centres, the majority of centres do not prepare strict programme documents.** Even though it followed from the studies conducted by the ERI associates that a definite majority of centres of non-formal education conduct science activities on the basis of an in-house programme<sup>5</sup>, quality study has revealed that such programme frequently does not function as a separate document. Programme documents of centres included in the report analyses were general materials of the centre presenting its educational activity within the scope of conduct of science activities where the observed activities formed a part. Closest to programme documents were, in this situation, all studies presenting the centre and its educational offer – thence bulletins, leaflets, activity schedules for a given school year. What is more, within this framework, the documents were also much diversified – with respect to volume, presented content, manners of describing the purpose and subjects of activities. Variety of such documents results from variety of manners of operation of centres, applied methods and the scope of presenting it. Apart from information and promotional materials, it is also possible to list documents presenting the programme of educational activity of a centre in the form of a guidebook (e.g. 216 Small Scale Chemistry Centre). It is also necessary to mention that centres sometimes presented their offer at Internet sites. However, Internet sites were not analysed. In some cases centres indicated its Internet site as the only form of presentation of the programme of educational activity. In such a case, a request was made to indicate a specific document/ link/ tab and only this fragment of the site as the programme document of the centre was subjected to analysis (e.g. Polesie National Park).

On account of the observations above, the manifestation of good practice could be preparation by a centre of programme documents which **clearly determine the objectives and assumptions for educational activity of the centre, manner of their implementation, sources of inspiration**, as well as – which is significant from the point of view of this study – **references to the NSC and skills related to scientific reasoning**. In the study, no document was found which could comply with all the requirements above.

Taking into account the informative function of programme documents (most often educational offers), it is necessary to say that their recipients may expect to find information in them which would allow for ascertaining the degree in which the centre's offer fulfils their needs and expectations. In the context of activities for groups of pupils supervised by teachers, this means **a possibility of stating whether given activities contain content compliant with reaching objectives of the NSC for a specific subject and whether they assume development of skills related to scientific reasoning**.

Among the ascertained determinants conducive to compliance with the best practice criteria, it is possible to include insertion of the following information in the documents:

- set of subjects along with information about their availability and target groups (in particular the educational stage) (e.g. 113 ZOO in Wrocław);
- characteristic of every activity with respect to:

---

<sup>5</sup> In the studies conducted by the ERI associates, no information was collected about the form in which such "in-house" programme functions.

- duration;
- general and specific objectives, making references to skills and competences;
- scope of substantive content taught in the course of activities;
- methods used during activities

(e.g. 201 Kujawy and Pomerania Centre of Ecological Education in Bydgoszcz).

In the group of best practices, it is also possible to include a situation where the information allows for **a clear statement that a centre offers activities compliant with the NSC**. Most often, conclusions of this type may be drawn on the basis of issues presented in the didactic offer (e.g. such information as “During the workshops, experiments with the use of a profile of an airplane wing will be performed in order to check the manner in which carrying capacity is achieved” testifies to the fact that the offered activity complies with the NSC general requirements for physics at the 3<sup>rd</sup> educational stage – II. Conduct of experiments and drawing conclusions from obtained results; 606 Municipal Engineering Museum in Cracow).

#### 4.4.2. Didactic Materials Used During Observed Activities

In the case of didactic materials used during the observed activities, we also had to deal with a significant degree of variety. Within the scope of activities, there were worksheets of various sizes, exercise books, written instructions of observations and experiments. The analysed didactic materials are materials directly related to the observed activities. Scenarios or outlines of specific activities, worksheets or exercise books used during the observed activities were included in the analyses.

Some of the materials constituted an element of a larger whole (e.g. the Notebook of Nature Researchers within the scope of the didactic programme “Forge of Nature Researchers” analysed as an element of a programme document, 11004 Eco-Initiative Association, Kwidzyn); other were devoted to one specific activity (e.g. a guidebook for participants of workshop “Yeast – Living Micro-Factory” 703 BioCEN Biocentre for Science Education).

#### Compliance of the substantive content of documents and materials with the NSC

There were materials **clearly compliant with the general and specific requirements of the NSC as was concluded from instructions contained in them** (e.g. 703 BioCEN BioCentre for Science Education, 216 Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry, Nicolaus Copernicus University, Toruń). Use of such materials has to be determined as an element conducive to occurrence of best practices, as they show that a pupil, performing tasks and instructions, works in a manner consistent with the manner required at school. In turn, such materials support the implementation of objectives of the new science curriculum.

#### Development of skills related to scientific reasoning

The content of some of the analysed materials indicates their **high utility in development of skills related to scientific reasoning**. It is also worth noting that without the use of materials, it is difficult to teach certain skills (e.g. registration of results of experiments and observations, presentation of results of experiments and observations).

The analyses indicate that proper use of didactic materials may support development of a majority of skills. The content of a worksheet and the nature of instruction are important in this case.

Instructions for conduct of experiments and observations were conducive to the shaping of such skills as:

- planning of experiments and observations;
- performance of experiments and observations;
- performance of measurements and studies on the basis of instructions.

On the other hand, materials containing the theoretical part and didactic objectives were conducive to the shaping of the following skills:

- presentation of hypotheses and formulation of questions;
- foreseeing and explaining dependencies among phenomena, processes and reactions;
- use of various sources of information (own knowledge and observations, texts, maps, photographs, etc.).

If the materials included space for recording the course of tasks or results, we can talk about conditions for development of such skills as:

- documenting the results of experiments;
- formulation of conclusions on the basis of results obtained in experiments or in the course of observations;
- presentation of results of experiments and observations.

Independently from the content, the materials also could have positive influence on extending the range of scientific vocabulary and be helpful in solidification of knowledge.

Some of the materials were solely instructions and did not offer space for documenting observations, recording conclusions (e.g. 1104 Eco-Initiative Association, Kwidzyn); others – on the contrary – contained descriptions of experiments and allowed for independent work of pupils when documenting the course of experiments and performance of calculations, as well as control questions used to check the work and to solidify the knowledge (e.g. Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry, Nicolaus Copernicus University, Toruń).

There were also more extensive materials, containing the entire scope of information – starting from theoretical information, via objectives of exercises, plans of experiments and instructions with a place for registration and analysis of results (e.g. 712 National Centre for Nuclear Research in Świerk).

### Utility in further studies

Elements of best practices also included materials for which the nature of instructions was conducive to independence of pupils. Majority of materials were of this type (e.g. 1004 Wigry Museum of Alfred Litiński – the Wigry National Park, 301 Polesie National Park, 201 Kujawy and Pomerania Centre of Ecological Education in Bydgoszcz, 209 Zoobotanical Garden in Toruń, 703 BioCEN BioCentre for Science Education, 712 National Centre for Nuclear Research in Świerk, 1104 Eco-Initiative Association, Kwidzyn, 1219 Ecological Education Centre Representative Bison Pen), even though in certain cases observations of activities indicated that conditions for independent work have not been properly used everywhere.

On the other hand, few materials were found which would be conducive to creative work of pupils. Instructions and exercises usually had imitative nature – they referred to recording the course of an observation or an experiment in a specific manner (e.g. prepared tables), filling in of fields or provision of answers to the question on the basis of the provided information or observations.

Elements at least partially conducive to creative work are instructions regarding solidification of observations in drawings, appearing in materials for youngest pupils (e.g. 201 Kujawy and Pomerania Centre of Ecological Education in Bydgoszcz).

#### **4.5. Examples of Best Practices Diagnosed in Non-Formal Education Centres**

The table below contains a list of centres that comply with the best practice criteria in individual areas along with specification which determinants testify to it.

**Table 3. Tabular presentation of the list of centres of non-formal education which are examples of best practice**

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
1	102	Didactics and Astronomy Popularization Division at the Astronomical Institute of the Wrocław University	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: maintenance of statistics of groups visiting the centre;</p> <p>In area 2: procurement of feedback from group supervisors after each activity; the centre's objectives include arousing interest in science and popularization of knowledge about astronomy; the activities rely on the provisions of the NSC and supplement the school programme;</p> <p>In area 3: selection of persons conducting the activities solely among experts and, at the same time, astronomy enthusiasts; compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning (performance of observations, determination of cause-and-effect relations);</p> <p>In area 4: compliance of didactic materials with general requirements of the NSC for science.</p>
2	107	Environmental Education Centre in Krośnice	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of multiple sources of financing for the educational activity (co-financing from local government, funds from sponsors, EU funds, fees for activities); maintenance of statistics of groups visiting the centre; various employment forms of educators on account of seasonal traffic intensity;</p> <p>In area 2: consulting the programme with professional advisors; evaluation of activities; combining the centre's operations with the life of the local community for the purpose of using its resources;</p> <p>In area 3: selection of persons conducting the activities in line with their passions and openness to their ideas regarding the programme; emphasis on direct experience; compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				<p>reasoning (performance of observations, determination of cause-and-effect relations).</p> <p>In area 4: inclusion in the offer – the programme document - of a list of skills developed by pupils during activities; scenario of observed activities compliant with the NSC teaching objectives, assumes independent and creative work of pupils.</p>
3	113	ZOO in Wrocław - Spółka z o.o. – Marketing and Education Division	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of various sources of financing for educational activity (co-financing from local government, fees for visiting and classes); maintenance of precise statistics of visitors; separation of the Marketing and Education Division which focuses on tasks related to educational activity and promotion; maintenance of a list of teachers visiting the centre for the purpose of contact maintenance; flexible employment forms of educators, which enables cooperation with a greater number of them;</p> <p>In area 2: NSC as a source of guidelines for creation of a programme of activities; evaluation of activities by teachers during introduction of new subjects to the offer;</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of shaping observation skills related to scientific reasoning;</p> <p>In area 4: offer of the centre presenting the subjects of classes in a concise manner and containing records testifying to their compliance with general requirements of the NSC and creation of conditions for the shaping of skills important in science education.</p>
4	201	Kujawy and Pomerania Centre of Ecological Education in Bydgoszcz	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> </ol>	<p>In area 1: establishment of an association due to lack of organizational and legal independence of the centre, hindering procurement of additional sources of financing;</p> <p>In area 2: objectives are focused on support of the school in science</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
			3. Performance of activities 4. Didactic and programme materials	<p>education and encouraging pupils to use their own knowledge and skills; use of the attractive location with respect to didactics; promotion of ecology via art; exchange of experiences and materials with other entities; adjustment of subjects to the needs of classes and upon individual order; making the library resources available to teachers and pupils;</p> <p>In area 3: offering field trips and workshops, including laboratories and activities with microscopes; compliance of observed activities with teaching objectives of the NSC and possibility of teaching skills related to scientific reasoning (performance of observations, formulation of conclusions, determination of cause-and-effect relations).</p> <p>In area 4: compliance of the programme document with general requirements of the NSC; specification of conditions for the teaching of skills important in science education and methodological assumptions conducive to the teaching of such skills; use of a worksheet compliant with general requirements of the NSC, conducive to independent and creative work of pupils.</p>
5	202	Wrocław Centre of Ecological Education	1. Administration and financing 2. Organization of the centre's operation 3. Performance of activities 4. Didactic and programme materials	<p>In area 1: use of multiple sources of financing of educational activity (co-financing from the local government, funds from sponsors, own funds); maintenance of statistics of visitors.</p> <p>In area 2: support for school in the process of science education: activities in the centre are a supplement for school activities – provision of additional science content; conduct of workshops for teachers; cooperation with the local environment; the NSC is the point of reference during preparation of didactic activities;</p> <p>In area 3: application of forms and methods of work conducive to implementation of the NSC objectives; compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning (performance of observations, determination of</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				<p>cause-and-effect relations);</p> <p>In area 4: the centre's programme document complies with the NSC and contains provisions testifying to assurance of conditions for shaping skills important in nature education related to scientific reasoning and application of methods conducive to it: didactic materials used during the observed activities are conducive to implementation of the NSC objectives and independent work of pupils.</p>
6	209	Zoobotanical Garden in Toruń	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: maintenance of statistics of visitors;</p> <p>In area 2: employment of enthusiasts – specialists in the field; broad offer of subjects with a possibility of modifying them upon request, according to the needs;</p> <p>In area 3: combining education with play; selection of persons conducting the activities in line with their interests and passions; compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning (observations, formulation of conclusions, determination of cause-and-effect relations, supporting one's stance with material arguments);</p> <p>In area 4: use of worksheets compliant with general requirements of the NCS, conducive to independent work of pupils.</p>
7	211	Forest School at Barbarka	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of multiple sources of financing for educational activity: funds of the Voivodeship Fund for Environmental Protection, EU funds, funds from sponsors, assistance of donors, provision of 1% from taxes and fees for activities, accommodation services, a store; maintenance of statistics of visitors;</p> <p>In area 2: maintenance of close relations with schools and teachers interested in science education; organization of courses and training sessions for teachers; making the centre available for teachers with their</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				<p>own programmes; NSC is known to the persons conducting the activities; when constructing the offer, they try to go beyond its frames and to transfer important knowledge for which there is no time during school classes; conduct of ongoing evaluation of activities among teachers;</p> <p>In area 3: active participation of pupils in activities, combining theoretical and practical activities; use of worksheets, e.g. a book with tasks which the children complete during activities and at school and at home, also available for individual visitors; compliance of the observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (performance of experiments, observations, formulation of conclusions, determination of cause-and-effect relations, supporting one's own stance with material arguments);</p> <p>In area 4: compliance of programme documents with the NSC requirements; they contain information testifying to creation of conditions conducive to the shaping of skills important in science education, related to scientific reasoning.</p>
8	216	Small Scale Chemistry Centre, Chemistry Didactics Division, Faculty of Chemistry, Nicolaus Copernicus University, Toruń	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: maintenance of a list of teachers visiting the centre for the purpose of maintaining contact;</p> <p>In area 2: promotion of chemistry in a manner attractive for school youth; provision of equipment for field trips; relying the centre's offer on the NSC;</p> <p>In area 3: workshop activities, assuming independence of pupils, showing experiments as present in every-day life; showing how to conduct interesting activities at a small cost; clear support for school classes (on account of regular customers); small number of pupils in groups allowing for independence and activity; compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (planning and performance of experiments and observations, formulation of conclusions, determination of cause-and-</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				<p>effect relations);</p> <p>In area 4: use of worksheets where the pupils describe the performed experiments, conducive to independent work; publication of a guidebook for teachers in cooperation with WSiP containing experiments proposed by the centre, fully compliant with the NSC requirements for chemistry.</p>
9	301	Polesie National Park	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of several sources of financing (NFEPWM and VFEPWM, payment for classes with instructors – the exception are schools located in communes within the borders of the Park and adjoining communes; commune budget); maintenance of statistics of visitors;</p> <p>In area 2: main purposes of the centre's operation include protection of peat bogs, protection of local animal and plant species and science education; when activity scenarios are prepared, the NSC is consulted; activities take place primarily in the field; they may be supplemented with workshops in didactic premises;</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning (performance of experiments and observations, determination of cause-and-effect relations);</p> <p>In area 4: programme document compliant with the NSC assumptions, provisions testify to implementation of general requirements compliant with the NSC.</p>
10	302	Roztocze National Park	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> </ol>	<p>In area 1: use of various sources of financing for operations (state budget, NFEPWM, VFEPWM, Local Action Group Development of Rural Areas, local government funds); maintenance of statistics of visitors;</p> <p>In area 2: taking the NSC into account during preparation of offer; conduct of stationary classes, field trips and activities at schools, cooperation with local government authorities and with patron schools in the vicinity of the</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
			4. Didactic and programme materials	Park; In area 3: compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (determination of cause-and-effect relations); In area 4: didactic materials used during activities comply with the general requirements of the NSC and assume the possibility of independent and creative work of pupils.
11	307	Nature Museum, Division of the Vistula Museum	1. Administration and financing 2. Organization of the centre's operation 3. Performance of activities 4. Didactic and programme materials	In area 1: use of various sources of financing for operation (marshall's office, funds from sponsors, VFEPWM, grants and subsidies, own funds); maintenance of statistics of visitors; In area 2: educational activity taken into account in the centre's charter as second after exhibition activity; offering one-time or cyclical activities; possibility of modifying and ordering specific subjects of activities; possibility of conducting activities at schools; In area 3: encouraging pupils to independent performance of tasks, observations of activities; compliance of observed activities with the NSC teaching purposes and possibility of shaping skills related to scientific reasoning (determination of cause-and-effect relations); In area 4: the programme document complies with the general requirements of the NSC, takes into account familiarizing the pupils with methods of studies, formulating conclusions and planning of experiments; contains information testifying to creation of beneficial conditions for shaping of skills important in science education and use of methods conducive to it; didactic materials comply with general requirements of the NSC and are conducive to independent work of pupils.
12	4062 (406.2)	Nature Museum of the Faculty of Biological Sciences of the Zielona Góra University	1. Administration and financing 2. Organization of the	In area 1: use of university resources (academic personnel, premises and equipment for activities), maintenance of statistics of visitors; In area 2: among main objectives of the centre, there is focus on showing

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
			<p>centre's operation</p> <p>3. Performance of activities</p> <p>4. Didactic and programme materials</p>	<p>nature in an involving and interesting manner, combined with direct experiments; combining the idea of student internship with animals with internship from the area of didactics, use of student volunteers from the Faculty of Biology of the Zielona Góra University; use of the NSC as a point of reference for the offer's authors; teaching via individual experiments (experiencing nature, possibility of touching the animals, breaking stereotypes, independent performance of experiments, etc.);</p> <p>In area 3: provision of proper servicing for activities (the person conducting the activity with at least two assistants), required teacher's/ group supervisor's presence during activities; selection of persons conducting the activities in line with their interests and passions from various areas of biology; compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning (performance of observations, determination of cause-and-effect relations);</p> <p>In area 4: the outline of observed activities contains provisions compliant with the NSC teaching objectives; it assumes independent and creative work of pupils.</p>
13	407	"Warta Estuary" National Park – Nature Garden of Senses	<p>1. Administration and financing</p> <p>2. Organization of the centre's operation</p> <p>3. Performance of activities</p> <p>4. Didactic and programme materials</p>	<p>In area 1: procurement of funds from various sources (VFEPWM, EU funds, own operation – including tourism, organization of training sessions, exhibitions and activities);</p> <p>In area 2: broad range of subjects; use of nature values of the Park; adjustment of activities to individual needs of the group; extensive resources for performance of activities; broad range of didactic aids; the offer includes field trips, labs, lectures and presentations; usually, various forms of activities are combined; activation of pupils by encouraging them to work out their own solutions;</p> <p>In area 3: compliance of observed activities with the NSC teaching</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				objectives and possibility of teaching skills related to scientific reasoning; In area 4: compliance of the programme document with general requirements of the NSC; used didactic materials comply with general requirements of the NSC and assume independent and creative activities of pupils.
14	501	"Źródła" Centre for Ecological Activities	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of funds from various sources (funds from the NFEPWM and VFEPWM, funds from own operation: deposits, payment for certain activities); maintenance of statistics of visitors, mainly on account of formal requirements for submission of applications for subsidies;</p> <p>In area 2: the purpose of the centre's operations is, primarily, ecological education addressed to groups supervised by teachers; the NSC is taken into account during creation of the programme in order to make it easier for the teachers to include the workshops in the curriculum and participate in them; conduct of training sessions for teachers;</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (determination of cause-and-effect relations, supporting own stance with material arguments);</p> <p>In area 4: didactic materials compliant with general requirements of the NSC, conducive to independent and creative work of pupils.</p>
15	505	"In the Łagiewniki Forest" Centre for Ecological Education, Branch No. 2 Centre of Out-of-School Activities No. 1	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: procurement of funds from various sources (City Office, EU funds, fees for activities); maintenance of statistics of visitors and using them for the planning of subsequent activities.</p> <p>In area 2: the main purposes of the centre's operations include ecological and educational activity addressed to youth groups supervised by teachers; taking the NSC into account during preparation of activities – activities in the centre extend the knowledge of pupils via practical activities and support teachers in the implementation of school</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				<p>programme; the offer mainly includes field trips; in principle, various forms of activities are combined and children and youth are encouraged to independent performance of tasks, observations, experiments, analyses, as well as teamwork; evaluations with teachers after every activity;</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (performance of observations, determination of cause-and-effect relations, formulation of conclusions);</p> <p>In area 4: use of didactic materials compliant with general requirements of the NSC, conducive to independent work of pupils.</p>
16	508	"Łódź Hills" Landscape Park	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of various sources of financing (funds from the voivodeship authorities, VFEPWM); maintenance of statistics of visitors;</p> <p>In area 2: objectives of the centre are focused on creation of conditions in which the participants of education will understand the need of conserving nature, education within the scope of protection of nature of a landscape park and education via play, activation of pupils; becoming familiar with animate and inanimate nature and history and culture of the area; cooperation with the Centre of Culture and Ecology; conduct of activities also at schools;</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning (performance of observations, formulation of conclusions, determination of cause-and-effect relations).</p> <p>In area 4: used didactic materials comply with the requirements of the NSC; independent work of pupils is enabled.</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
17	606	Municipal Engineering Museum in Cracow	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of various sources of financing (own funds, city's funds, fees for activities, subsidies); maintenance of statistics of visitors;</p> <p>In area 2: support for the school in the process of science education among objectives of operations; assumptions and educational approach focused on allowing the pupils to perceive and present their own knowledge and skills; taking the NSC into account in the programme (both with respect to skills and the scope of knowledge and the required experiments);</p> <p>In area 3: the offer includes activities in small groups to ensure the possibility of team work; almost each of the offered workshops features elements of experimental method; conduct of activities with the use of simple, generally available materials and aids and with slight financial outlays; compliance of observed activities with teaching objectives of the NSC and possibility of shaping skills related to scientific reasoning (planning and performance of experiments and observations, formulation of conclusions, determination of cause-and-effect relations);</p> <p>In area 4: programme document – a leaflet with the centre's programme contains provisions testifying to the programme's compliance with the general requirements of the NSC and creation of conditions conducive to the shaping of skills important in science education.</p>
18	617	Pieniny National Park	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: maintenance of statistics of visitors; establishment of an educational unit;</p> <p>In area 2: conduct of activities in educational premises, field trips, activities at schools.</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (performance of experiences and observations, supporting own stance with material arguments).</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				In area 4: didactic materials compliant with general requirements of the NSC, enable independent work of pupils.
19	702	Copernicus Centre of Science	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of various sources of financing (local government funds, ministry funds, funds from sponsors); maintenance of statistics of visitors;</p> <p>In area 2: groups of pupils supervised by teachers are the main recipients of the centre's activities; the centre complies with the school programme; extensive didactic database; the utilized methods include experiments, observations and discussions;</p> <p>In area 3: compliance of activities with the NSC teaching objectives and a possibility of shaping skills related to scientific reasoning (performance of experiments and observations, determination of cause-and-effect relations);</p> <p>In area 4: didactic materials compliant with general requirements of the NSC for chemistry; they assume independent and creative work of pupils.</p>
20	703	BioCEN BioCentre for Science Education	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of various forms of financing (funds from institutions co-creating the centre, funds from the local government, sponsors, EU funds, fees for activities); establishment of a foundation allowing for procurement of funds from grants; maintenance of statistics of visitors;</p> <p>In area 2: promotion of biology among school youth – objective of the centre, treating the NSC as a point of reference for the offer's authors; collection of opinions of activity participants (questionnaires);</p> <p>In area 3: offering laboratory activities in small groups, enabling independent work with two persons conducting the activity; compliance of the observed activities with the NSC teaching objectives and a possibility of teaching skills related to scientific reasoning (performance of experiments and observations, formulation of conclusions, determination</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				of cause-and-effect relations); In area 4: offering didactic materials compliant with the general requirements of the NSC, conducive to independent work.
21	712	National Centre for Nuclear Research in Świerk	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of several sources of financing, including funds from a superior institution, fees for activities and EU funds; employment of a specialist for procurement of EU funds; maintenance of statistics of schools and teachers visiting the centre; separation of an Educational and Training Division of the NCNR which focuses on tasks related to educational activity;</p> <p>In area 2: among objectives of the centre, there is promotion of issues of nuclear physics and breaking the stereotypes – also in the form of activities; supplementing the offer of activities with competitions for pupils of middle schools and secondary schools co-organized with the Institute of Physics of the Polish Academy of Sciences; personnel consisting of enthusiasts and experts in the area;</p> <p>In area 3: the offer includes laboratory activities in small groups with assistance of persons conducting the activity for every group; compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (planning and performance of experiments and observations, formulation of conclusions, determination of cause-and-effect relations, supporting own stance with material arguments);</p> <p>In area 4: didactic materials compliant with the general requirements of the NSC, conducive to independent and creative work of pupils.</p>
22	723	Museum of Technology in Warsaw	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> </ol>	<p>In area 1: maintenance of statistics of visitors; maintenance of a list of teachers visiting the centre for the purpose of keeping in touch;</p> <p>In area 2: main objectives of the centre focus on promotion of issues from the area of physics in a manner attractive for school youth, conduct of</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
			3. Performance of activities	<p>activities for groups of pupils supervised by teachers is the basic area of the centre's operation; focus on showing nature in an interesting manner, with direct experiments/ contact with nature; selection of persons conducting the activities in line with their interests, passions in various scientific areas; ongoing collection of evaluation of activities from participants;</p> <p>In area 3: the offer includes laboratory classes in small groups; compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (performance of observations, determination of cause-and-effect relations, expressing opinions, supporting own stance with material arguments).</p>
23	725	Physics Workshop at the Faculty of Physics at the Warsaw University	1. Administration and financing 2. Organization of the centre's operation 3. Performance of activities 4. Didactic and programme materials	<p>In area 1: maintenance of statistics of activity participants; procurement of funds from various sources (city office, EU projects, funds from the Polish Physics Society, funds of the Faculty of Physics);</p> <p>In area 2: objectives of the centre's operation encompass support for schools in implementation of the curriculum; the NSC provides guidelines for authors of activities, it is treated as a source of subjects;</p> <p>In area 3: organization of activities in the form of cycles; conduct of activities in small groups, thanks to which pupils have an opportunity of performing experiments; performance of activities by didactic personnel of the Faculty of Physics of the Warsaw University; compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning (planning and performance of experiments and observations, formulation of conclusions, determination of cause-and-effect relations, supporting own stance with material arguments);</p> <p>In area 4: didactic materials used during the observed activities are conducive to implementation of general requirements of the NSC and</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				enable independent work of pupils.
24	729	Botanical Garden of the University of Warsaw	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of various sources of financing: VFEPWM, NFEPWM, admission fees, tickets and servicing by a tour guide during trips in the garden; plans are made to procure EU funds; maintenance of statistics of visitors; cooperation with students within the scope of performance of activities;</p> <p>In area 2: the offer includes workshops in the course of which participants may perform experiments, take part in simplified research studies;</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (performance of experiments and observations, determination of cause-and-effect relations);</p> <p>In area 4: didactic materials used during the activities comply with the general requirements of the NSC and assume independent work of pupils.</p>
25	911	Centre for Ecological Education in Przeclaw at the Municipal Centre of Culture	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: maintenance of statistics of visitors;</p> <p>In area 2: among purposes of the centre, there is support for schools in the process of science education and extension of ecological knowledge; adjustment of activities to the teaching programme on the basis of the NSC, combining the centre's operation with the life of a local community;</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning (determination of cause-and-effect relations, supporting own stance with material arguments).</p> <p>In area 4: didactic materials used during the observed activities comply with general requirements of the NSC and enable independent and</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				creative work of pupils.
26	920	Chamber of Forest Education, Jarosław Forest Inspectorate	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: maintenance of statistics of visitors;</p> <p>In area 2: possibility of conducting activities at schools; possibility of using or renting didactic resources of the centre; supplementing the didactic offer by organization of competitions for pupils;</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (performance of observations and experiments, formulation of conclusions);</p> <p>In area 4: the programme document contains information about equipment of the centre conducive to the shaping of skills related to scientific reasoning; didactic materials used during the observed activities comply with implementation of general objectives of the NSC and enable independent work of pupils.</p>
27	1001	Centre for Science Education of the Białowieża National Park	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of multiple sources of financing for the educational activity (entrance fees to the museum, tour guides, activities, lease of conference rooms, subsidies obtained from EU funds and from the foundation); maintenance of statistics of visitors and their use in applying for EU funds and participation in competitions;</p> <p>In area 2: among objectives of operation, there is science and ecology education; cooperation with other centres, joint implementation of an ecological education project "Following the Bison's Trail"; organization of activities at schools; activities for the benefit of the local community (e.g. out-of-school activities for children from the area, organization of events); use of current textbooks (compliant with the NSC) and preparation of</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				<p>activity scenarios; the number of employees allows for servicing several groups at a time; evaluation of activities both with respect to external programmes, as well as internal ones, occasional examination of needs among teachers and parents;</p> <p>In area 3: limiting the number of pupils in groups during activities in the strict reserve;</p> <p>In area 4: exercise book compliant with the NSC general requirements, conducive to independent work of pupils, enables documentation of results of observations, allows for checking and solidification of knowledge and skills taught during activities.</p>
28	1002	Biebrza National Park – Centre for Education and Management	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: procurement of funds from various sources (EU funds, own funds); maintenance of statistics of visitors;</p> <p>In area 2: objectives of the centre focus on ecological education addressed to groups of pupils supervised by teachers;</p> <p>In area 3: emphasis on independent work of pupils; use of various work methods (e.g. observations in the field, worksheets); compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (performance of experiments and observations, determination of cause-and-effect relations);</p> <p>In area 4: didactic materials compliant with general requirements of the NSC, conducive to independent work of pupils.</p>
29	1004	Wigry Museum of Alfred Litiński, Wigry National Park	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme</li> </ol>	<p>In area 1: maintenance of statistics of visitors; use of various sources of financing (the Park's budget, entrance fees to the Museum, fees for culture and science activities – with the exception of schools from the area of the Wigry National Park and its protection zone, EU funds, agreements with communes);</p> <p>In area 2: cooperation with the Teachers' Training Centre during consultation of lesson scenarios with methodological advisors; use of the</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
			materials	<p>NSC and school textbooks during preparation of activities for the purpose of checking the pupils' knowledge on a given level of education and adjustment of the language, scope and subjects of classes to this level; making the Centre available to teachers with their own programme; emphasis on the shaping of information analysis and conclusion drawing skills;</p> <p>In area 3: active participation of pupils in activities (worksheets, quizzes, crosswords, art classes); interactive nature of activities (possibility of touching a beaver, examining water with one's own hands, working with a microscope); compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (performance of experiments and observations, formulation of conclusions, determining cause-and-effect relations, supporting one's own stance with material arguments);</p> <p>In area 4: programme document compliant with the NSC general requirements, contains provisions testifying to development of conditions for the shaping of skills important in science education – related to scientific reasoning; didactic materials used during the observed activities are conducive to implementation of general objectives of the NSC and enable independent work of pupils.</p>
30	1101	Centre for Ecological Information and Education in Gdańsk	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of various sources of financing for educational operations (annual subsidies from the superior unit, from the city authorities and the voivodeship, the local government and other entities commissioning activities or organization of specific events); maintenance of statistics of visitors;</p> <p>In area 2: main objectives of the centre focus on promotion of ecology, environmental protection and biology in a manner attractive for young people; knowledge is transferred in a multidisciplinary manner, allowing for</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				<p>a broader look on the discussed subjects and enabling interdisciplinary teaching; promotion of ecology via entire range of activities, not only strictly educational (competitions, educational activities, annual events) - learning by playing; cooperation with schools on many fields of operation of the centre (including consultations of the programme); reaching to the NSC during preparation of activities; following the assumptions of the NSC in order to adjust the thematic scope to the school curriculum;</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning (formulation of conclusions, supporting own stance with material arguments);</p> <p>In area 4: programme document and didactic material compliant with the general requirements of the NSC, conducive to independent work of pupils.</p>
31	1102	EXPERYMENT Centre of Science	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of various sources of financing educational activity (Gdynia City Office, projects financed from the EU, South Baltic); maintenance of statistics of visitors for marketing purposes;</p> <p>In area 2: education and activation of pupils and teachers is the most important area of operation of the centre; main recipients of the centre's activities are groups of pupils supervised by teachers; evaluation of activities in the form of questionnaires at Internet sites, within the scope of ISO-9001:2009, support for teachers, inter alia by training programmes.</p> <p>In area 3: during activities, various methods are used: lectures, experiments, exercises in order to develop interests, make the pupils involved in classes and arouse their curiosity, entice them to independent activity; compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (formulation of conclusions, determination of cause-and-effect relations,</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				<p>supporting own stance with material arguments);</p> <p>In area 4: programme document compliant with the general requirements of the NSC, contains provisions indicating that the centre creates conditions conducive to shaping skills important in science education and applies relevant methods; didactic materials compliant with the general requirements of the NSC, conducive to independent and creative work of pupils.</p>
32	1103	EduPark Centre of Education for Children and Young People of the Gdańsk Science and Technology Park	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of multiple sources of financing educational activity (Pomerania Special Economic Zone, own funds, VFEPWM); maintenance of statistics of visitors;</p> <p>In area 2: feedback from teachers after every activity; the purpose of the centre's operation is teaching by playing addressed primarily to organized groups of school children and preschool groups supervised by teachers; taking the NSC into account during preparation of the programme;</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning (performance of experiments and observations, determination of cause-and-effect relations);</p> <p>In area 4: the programme document of the centre complies with the general requirements of the NSC and contains provisions testifying to assurance of conditions conducive to the shaping of skills important in science education – related to scientific reasoning and methodological assumptions; didactic materials compliant with general requirements of the NSC conducive to independent work of pupils.</p>
33	1104	Eco-Initiative Association, Kwidzyn	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the</li> </ol>	<p>In area 1: use of multiple sources of financing for educational activity (funds from local government: budget and earmarked funds within the scope of projects, funds from sponsors and from economic operations,</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
			centre's operation 3. Performance of activities 4. Didactic and programme materials	<p>funds from PFEP); maintenance of detailed statistics of visitors (requirement of subsidies);</p> <p>In area 2: ecological education for youth groups supervised by teachers among objectives of operation; conduct of programme "Forge of Nature Researchers" teaching research methods in sciences; taking the NSC into account during creation of the programme offer – activity scenarios created with a thought for supporting teachers in programme implementation; conduct of evaluations with teachers after every activity;</p> <p>In area 3: the offer includes field activities, labs, lectures, combining various subjects; in principle, various forms of activities are combined and young people are encouraged to independent performance of tasks, observations and experiments; compliance of observed activities with the NSC teaching objectives and possibility of shaping of skills related to scientific reasoning (planning and performance of experiments and observations, formulation of conclusions, determination of cause-and-effect relations, supporting own stance with material arguments);</p> <p>In area 4: programme document compliant with the general requirements of the NSC, contains provisions indicating that the centre creates conditions conducive to the shaping of skills important in science education and applies conducive methods; didactic materials compliant with the general requirements of the NSC, conducive to independent work of pupils.</p>
34	1105	Culture Park of City Fortifications	1. Administration and financing 2. Organization of the centre's operation 3. Performance of activities 4. Didactic and programme	<p>In area 1: use of various sources of financing (own funds, funds from sponsors); maintenance of statistics of visitors; a division dealing with procurement of EU funds;</p> <p>In area 2: taking the NSC into account during preparation of the offer for the purpose of supporting teachers in implementation of the school programme; cooperation with academic institutions; evaluation of activities</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
			materials	<p>with pupils; consultations with teachers; making the centre's database available to teachers for independent organization of activities;</p> <p>In area 3: the offer includes field trips, lectures; in principle, various forms of activities are combined and children and young people are encouraged to independent performance of tasks, observations and experiments; compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning (performance of experiments and observations, formulation of conclusions);</p> <p>In area 4: programme document of the centre complies with the general requirements of the NSC and contains provisions testifying to creation of beneficial conditions for the teaching of skills important in science education and application of conducive methods; didactic materials compliant with the general requirements of the NSC, conducive to active work of pupils.</p>
35	1110	Gniew Centre of Ecological Education by the Association Centre for Active People in Gniew	<p>2. Organization of the centre's operation</p> <p>3. Performance of activities</p> <p>4. Didactic and programme materials</p>	<p>In area 2: the objectives of the centre include ecological education for groups of pupils supervised by teachers and support for the school; evaluation of activities in the form of questionnaires for pupils; possibility of modifying the activities depending on the recipients' needs and ordering activities; programme of activities developed on the basis of textbooks; teaching via direct contact with nature and individual experiments; cooperation with the centre of non-formal education in Kwidzyn in the form of exchange of experiences and materials; providing transport for field trips;</p> <p>In area 3: methods include experiments, exercises, field trips, workshops; use of didactic aids of own production created with small financial outlays; compliance of observed activities with the NSC teaching objectives and a possibility of shaping skills related to scientific reasoning (performance of experiments and observations, supporting own stance with material</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				<p>arguments);</p> <p>In area 4: programme document compliant with the general requirements of the NSC, contains provisions indicating that the centre creates conditions conducive to the teaching of skills important in science education and applies relevant methods; didactic materials comply with the NSC general requirements and are conducive to independent work of pupils.</p>
36	1114	Gdynia Aquarium of the Maritime Fishing Institute – State Research Institute	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of various sources of financing for educational activity (budget of the Maritime Fishing Institute, earmarked subsidies from the NFPEWM and VFPEWM, funds for performed educational orders from the City Office, funds from own operation (sale of tickets, educational services);</p> <p>In area 2: educational activity in the area of biology, sea, ecology and environmental protection is, next to exhibition activity (live exhibition), the main purpose of the centre's operation; broad range of subjects – workshops organized on a one-time basis and cyclically;</p> <p>In area 3: the offer includes workshops, laboratory activities, lectures, “wet” activities (touching live fish); in principle, various forms of activities are combined and children and young people are encouraged to independent performance of tasks, observations and experiments; compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (planning and performance of experiments and observations);</p> <p>In area 4: the programme document complies, to a high degree, with general requirements of the NSC and testifies to the fact that activities conducted by the centre make the pupils familiar with study methods, formulation of conclusions and planning of experiments; it contains provisions indicating that the centre creates conditions conducive to the</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				shaping of skills important in science education and applies relevant methods; the didactic materials comply with the general requirements of the NSC with respect to the subjects of biology and geography; it is conducive to independent work of pupils.
37	1115	Green School in Schodno	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: maintenance of statistics of visitors; evaluations with teachers and pupils after every activity;</p> <p>In area 2: the objectives of the centre include science and ecological education for groups of pupils supervised by teachers; broad range of subjects with a possibility of modifying or commissioning specific activities; main purposes of the centre include showing nature in an involved and interesting manner with direct experience/ contact with nature/ science; the NSC is taken into account during preparation of the programme;</p> <p>In area 3: the offer includes field trips, lectures, workshops; in principle, various forms of activities are combined and children and young people are encouraged to independent performance of tasks, observations and experiments; compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning (conduct of experiments and observations);</p> <p>In area 4: programme documents compliant with the general requirements of the NSC assume making the pupils acquainted with study methods, formulation of conclusions and planning of experiments; they indicate creation of beneficial conditions for the shaping of skills important in science education and application of methods conducive to it.</p>
38	1116	Pomerania Complex of Landscape Parks in Słupsk, Complex Division in Kościerzyn, Wdzydze	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> </ol>	<p>In area 1: use of various sources of financing (VFEPWM and NFEPWM, funds from sponsors and local government);</p> <p>In area 2: development of educational offer in cooperation with schools and teachers, taking into account the general requirements of the NSC;</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
		Landscape Park	3. Performance of activities 4. Didactic and programme materials	possibility of conducting activities at schools; broad selection of subjects with a possibility of modifying them; In area 3: the offer includes laboratory activities; compliance of the observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (determination of cause-and-effect relations, formulation of conclusions); In area 4: the programme document complies with the general NSC requirements and contains information testifying to development of conditions for the teaching of scientific reasoning skills and application of relevant methods.
39	1122	University for Children of the Pomeranian Academy in Słupsk	1. Administration and financing 2. Organization of the centre's operation 3. Performance of activities 4. Didactic and programme materials	In area 1: maintenance of statistics of activity participants; In area 2: taking the NSC indirectly into account during development of the educational offer of the centre (textbooks, consultations with teachers); In area 3: during activities, emphasis is put on independent work of pupils and development of pupil's interests; full activation of pupils during observed activities; compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning (determination of cause-and-effect relations); In area 4: didactic materials compliant with the general NSC requirements, enabling independent work of pupils.
40	1124	"The Słupia Valley" Landscape Park, branch of Pomerania Complex of Landscape Parks,	1. Administration and financing 2. Organization of the centre's operation 3. Performance of activities 4. Didactic and programme materials	In area 1: use of various sources of financing for educational activity (marshall's office, NFEPWM, VFEPWM, paid activities, EU subsidies); statistics of visitors are maintained; In area 2: science and ecological education are objectives set on the same level as active nature protection; main recipients are organized groups of children supervised by teachers; In area 3: great emphasis on activity of children in the field and their direct contact with nature; compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				<p>reasoning (determination of cause-and-effect relations).</p> <p>In area 4: the programme document of the centre complies with the NSC general requirements; the didactic materials comply with the NSC requirements and are conducive to group work of pupils, develop their independence and skills related to scientific reasoning.</p>
41	1210	"Earth and Us" Association of Ecological Education	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> </ol>	<p>In area 1: use of various sources of financing (EU funds, municipal funds, transfer of 1% of tax); maintenance of statistics of visitors;</p> <p>In area 2: development of pro-ecological stances among the centre's objectives; use of methods activating the pupils (e.g. worksheets, games and plays, drama); the NSC is the source of knowledge about the level of the pupils' knowledge;</p> <p>In area 3: performance of activities in small groups; compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning (performance of observations and experiments, determination of cause-and-effect relations).</p>
42	1211	Moravia Gate Arboretum in Racibórz	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: maintenance of a register of the number of participants of educational activities for reporting purposes;</p> <p>In area 2: main objectives of the centre include focus on showing nature that surrounds people in an engaging and interesting manner, with direct experience, supporting independence; the NSC is a point of reference for the offer's authors; use of natural environment for educational activity;</p> <p>In area 3: teaching via individual experience (experiencing nature, possibility of touching the exhibits); a holistic approach; offering of workshops, laboratories and field trips, possibility of organizing activities at schools, compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning i.e. performance of observations;</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				In area 4: provisions of the programme of science education testify to creation of conducive conditions with respect to the NSC; use of worksheets during the observed activities which enable documentation of the observation results.
43	1212	Coal Mining Museum in Zabrze	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> </ol>	<p>In area 1: procurement of funds from various sources (municipal funds, EU funds, sponsors); maintenance of statistics of visitors (for reporting and internal needs);</p> <p>In area 2: use of school books and opinions of teachers during preparation of activities;</p> <p>In area 3: activation of pupils during activities, emphasis on independent work; during workshops, the pupils are divided into groups in order to cooperate and, at the same time, perform some activities independently; compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning; performance of observations, determination of cause-and-effect relations, supporting own stance with material arguments.</p>
44	1219	Ecological Education Centre Representative Bison Pen	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of multiple sources of financing (including the VFEPWM and NFEPWM, economic and gastronomic activity), use of flexible employment forms of teachers; maintenance of detailed statistics of visitors;</p> <p>In area 2: cooperation with other centres with respect to implementation of the ecological education project; adjustment of activity scenarios to the NSC by a methodological advisor; introduction of activity evaluation in May 2012;</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning; performance of observations, determination of cause-and-effect relations;</p> <p>In area 4: activity outlines contain provisions testifying to their compliance</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				with the NSC general requirements; offering exercise books compliant with the NSC requirements, conducive to independent work of pupils and consistent with programme documents (activity outlines).
45	1220	Upper Silesian Museum in Bytom	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> </ol>	<p>In area 1: maintenance of statistics of visitors;</p> <p>In area 2: taking the NSC into account during preparation of an educational offer for the purpose of determining the thematic scope; emphasis on implementation of important, from the point of view of the NSC, teaching objectives and development of skills crucial in science education, related to scientific reasoning (independent observation, drawing of conclusions, stirring interest in nature), employment of didactic employees who are enthusiasts and specialists in a given area;</p> <p>In area 3: making it possible to allow the visitors to get to know nature in an organoleptic manner (the exhibits can be touched); compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning; determination of cause-and-effect relations.</p>
46	1225	Physics Didactics Division – University of Silesia	<ol style="list-style-type: none"> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> </ol>	<p>In area 2: main form of activity is promotion of physics and natural sciences by conduct of science activities for groups of pupils; conduct of activities by employees of the Faculty – specialists in the field; activities are also conducted in schools; offer of trainings for teachers devoted to performance of experiments and making the activities varied; activities based on the NSC; employees of the centre want to make it easier for the pupils to understand theory taught at school and to help the teachers implement the school programme;</p> <p>In area 3: methods used during activities include labs (the person conducting the activity performs experiments, involving pupils as assistants), lectures, presentations, supported by multimedia</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
				presentations, short film shows; compliance of the observed activities with the NSC teaching purposes and possibility of shaping skills related to scientific reasoning: planning and performance of experiments and observations, determination of cause-and-effect relations, separating opinions from facts, formulating conclusions on the basis of obtained results.
47	1228	Biology Didactics Division of the University of Silesia	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the centre's operation</li> <li>3. Performance of activities</li> <li>4. Didactic and programme materials</li> </ol>	<p>In area 1: use of various sources of financing (own funds, e.g. from fees for activities, city office, state subsidies, EU funds); maintenance of statistics of visitors;</p> <p>In area 2: among main objectives of the centre, there is building of ecological awareness and activation of school youth for ecological activity; evaluation of activities with participants; relying the activities on cooperation with other science and educational centres; taking the NSC into account during preparation of activities, supplementing the school programme with practical knowledge which cannot be taught at school;</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of shaping skills related to scientific reasoning: determination of cause-and-effect relations, distinguishing opinions from facts, supporting one's stance with material arguments;</p> <p>In area 4: programme document compliant with the NSC teaching objectives, contains information about creation of conditions for the shaping of skills related to scientific reasoning, equipment of the centre and application of relevant methods; use of didactic materials compliant with the general objectives of the NSC, conducive to independent work and encouraging creative thinking.</p>
48	1507	Centre of Regional and Science Education in Mniszki	<ol style="list-style-type: none"> <li>1. Administration and financing</li> <li>2. Organization of the</li> </ol>	In area 1: use of various sources of financing (funds from the commune budget, EU subsidies, funds from the conducted economic operations); maintenance of statistics of visitors;

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
			centre's operation 3. Performance of activities	<p>In area 2: the objectives of the centre focus primarily on science education addressed to youth groups supervised by teachers;</p> <p>In area 3: the offer includes field trips; in principle, various forms are combined and pupils are encouraged to independent performance of tasks, observations and experiments; compliance of one of the observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning: performance of experiments and observations, determination of cause-and-effect relations, distinguishing between opinions and facts, supporting own stance with material arguments.</p>
49	1601	Dendrological Garden, Local Government Budget Unit in Przelewiec	1. Administration and financing 2. Organization of the centre's operation 3. Performance of activities 4. Didactic and programme materials	<p>In area 1: use of various sources of financing for educational activity (commune funds, entrance tickets, sale of plants, festivals, conferences); maintenance of a register of tourist groups;</p> <p>In area 2: offer of laboratory activities; making the centre's resources available for independent performance of activities by teachers;</p> <p>In area 3: compliance of observed activities with the NSC teaching objectives and possibility of teaching skills related to scientific reasoning: performance of experiments and observations, formulation of conclusions, determination of cause-and-effect relations;</p> <p>In area 4: compliance of the programme document with general requirements of the NSC for science (2<sup>nd</sup> educational stage), biology (3<sup>rd</sup> and 4<sup>th</sup> educational stage) and chemistry (3<sup>rd</sup> and 4<sup>th</sup> educational stage); the document contains information about development of conditions conducive to scientific reasoning and application of relevant methods.</p>
50	1624	Solec Jurassic Park	1. Administration and financing 2. Organization of the	<p>In area 1: use of various sources of financing for educational activity (entrance tickets, paid workshops, other economic activity); maintenance of statistics of visitors;</p>

No.	No.	Name of centre	Area in which the centre is an example of best practice	Justification
			centre's operation 3. Performance of activities 4. Didactic and programme materials	<p>In area 2: the centre's programme is comparable to the NSC general objectives, possibility of conducting activities at schools; offer includes workshops;</p> <p>In area 4: the programme documents and the didactic materials from the observed activities comply with the general requirements of the NSC; the programme document indicates the intention of teaching skills important in school education (e.g. use of various sources of information, conduct of observations, distinguishing opinions from facts).</p>

## 5. Cross-sectional Analysis of the Situation Along with Evaluation and Recommendations for the Educational System, Indication of Possibilities and Opportunities Offered by Non-Formal Science Education

This chapter presents cooperation among centres of non-formal science education and partners who have important impact on the shaping of the educational offer for groups of pupils supervised by teachers and its implementation from the perspective of such centres. The data on which the below remarks and conclusions rely derive from in-depth individual interviews with employees of 50 centres in the area of Poland. The situation of examined centres of non-formal education depends on a number of factors. Most important factors, on account of the study objectives, will be discussed in detail. The study below will refer to the following issues:

- pupils using the educational offer;
- teachers visiting the centre with their groups;
- schools and their relations with the centre;
- the NSC and its impact on the centre's offer addressed to groups of pupils supervised by teachers;
- local community in which the centre operates;
- sources of financing the centre's operation.

### 5.1. Pupils from the Centre's Perspective

The centres show certain regularities regarding work of young people participating in the educational programmes offered by them, including groups of pupils supervised by teachers.

References were made both to the perceived preferences of pupils regarding the methods and the style of didactic work of the centre, as well as to the ascertained level of knowledge and interest of pupils observed by the researchers.

#### 5.1.1. Making Pupils Interested in Sciences

When analyzing the study results, we often encountered opinions voiced by the respondents that sciences are negatively perceived by young people – they are considered difficult and boring and in relation to this, school pupils do not like them. This is the result of the fact that they are little known and, which is of great detriment for them, underappreciated, in spite of being beautiful and fascinating.

Employees of the examined centres often intend to break these stereotypes and biased opinions, harmful for sciences.

*We show that biology is about experiments and knowledge that is useful on every-day basis. Due to the fact that a majority of people associate biology with book paragraphs, they do not realize that this is an every-day issue.*

*703. BioCentre for Science Education, professional and administrative employee*

*(Our objectives) primarily include promotion of sciences and, in particular, physics. However, we want to show that physics is present in our lives. It is not a difficult subject, contrary to everybody's opinion; everybody says that physics is too difficult and it is necessary to limit it so that young people are not tired. However, wherever we go and whatever we do, no matter whether it is a kitchen, a bathroom, or a camping site or nature, physics is always present and nature is also governed by rights described by physics. Physics has to be perceived everywhere; we have to encourage young people to look around them, to search for physics around them; we have to show them that it is really beautiful.*

*1225 Physics Didactics Division of the University of Silesia, professional employee*

The respondents' opinions suggest that the manner of teaching young people at schools is responsible for this image of science.

Irrespective of the actual manner of teaching at schools, the respondents indicated a number of problems which, in their opinion, occur in schools and influence the pupils' attitude to sciences. In the opinion of respondents:

- theoretical knowledge, difficult to acquire by pupils, dominates the teaching of sciences. This results in the fact that pupils have problems with understanding dependencies occurring in reality;
- at school, there is often no possibility of independent performance of experiments;
- sciences are often taught in separation from the natural environment, i.e. without references to every-day reality. In relation to this, scientific knowledge tends to be perceived by young people as useless and/ or little interesting;
- in particular, scientific milieus voiced opinions regarding harmful changes which have been taking place in the teaching programmes over a long period of time. In the opinion of some of the respondents, the content of school curricula from the area of sciences is systematically limited, which leads to aggravation of the level of knowledge of an average recipient of the centre's offer;

*The situation of teaching, as far as sciences are concerned, in spite of the opinion of the Ministry of National Education that believes that the current reforms or the reforms that took place changed the situation for the better, is not good. In relation to this, we are trying, as far as possible, to help the teachers.*

*725. Faculty of Physics of the University of Warsaw, professional employee*

- showing correlations and complementarity of knowledge from various areas of sciences is missing (e.g. physics and biology, etc.).

### 5.1.2. Level of Pupils' Scientific Knowledge

An opinion was voiced that the lifestyle of children and young people is not conducive to spontaneous interest in nature. "Digitization" of reality, computerization and transfer of some relations into the virtual reality become more and more common – not only in large cities. This results in the fact that children, in many respects, are "detached" from the elements of the world surrounding them and have difficulties with understanding the processes from the area of sciences occurring in it. The aspects that are considered particularly worrying and surprising include the fact that children are frequently lacking fundamental knowledge about the natural world surrounding them – they cannot distinguish native trees, animals, etc. Paradoxically, availability of educational programmes (TVP, Discovery, Animal Planet) makes them more familiar with exotic nature rather than domestic nature.

*It seems to me that this is not an issue of ideas; young people are very impoverished as far as observation skills are concerned. I do not know what it results from; maybe it is because everybody is sitting by their computers. I remember from my childhood that we used to go for various trips to the forest or to the zoo.*

*1211. Moravia Gate Arboretum, professional and administrative employee (dyad).*

As noticed by representatives of centres, young people also have difficulties with transferring the theoretical knowledge they have onto every-day life situations. It is believed that this may be a result of the manner of teaching at school which – in the respondents' opinion – puts more emphasis on implementation of programme elements rather than showing the system of dependencies. According to the respondents, pupils are often unable to perceive and use the knowledge they have from the area of sciences in practice, and it also happens that they consider it of limited utility.

*Unfortunately, there is huge hiatus between me and such persons. Gradating difficulty has to be present at all times, because it is known that children and young people are taught in different manners. But I see gaps here. So I often make references to geology and geography, whenever this is possible. And if I say Pimpek, that is our snake, a Chinese snake, comes from Central China, I often see that students do not know that a part of the Himalayas is Chinese and a part is Indian. A part is Nepalese. And when I ask them in which country does Mount Everest lie? This is a shock for them. Where do some plants that we have come from?*

*4062. Nature Museum in Zielona Góra, professional employee.*

### 5.1.3. Pupils' Preferred Style of Work

The above-listed remarks of employees of examined centres are often treated as a point of reference for the shaping of own educational offer of centres and selection of the manner of work with pupils.

Attention is drawn to the fact that often the most interesting and motivating aspect for the pupils is reaching for simplest, in the respondents' understanding, methods and forms of work. The following issues were mentioned:

- permitting free exploration – e.g. free movement in a specific area, possibility of collecting specimens, etc.;
- enabling independent experience – from hitting a drum to produce sound, to performance of complex laboratory experiments;

- influencing multiple senses at the same time – observation and recognition of sounds of nature outdoors, contact with a diorama<sup>6</sup>, etc.;
- work on very simple elements of the environment, close for the pupil – e.g. analysis of chemical composition of tap water, going to a meadow with a group, etc.

*The important thing is to teach by playing. Children go outside the building, collect samples of water or whatever they want. Here, from the pond, fragments of plants or even a wing of a butterfly; whatever they can find. Sometimes, we prepare samples ourselves. They (the children) look at them later under a microscope.*

301. Polesie National Park, professional employee.

*As far as selection of activities is concerned, we try to take into account subjects that enable practical aspects and offer a possibility of conducting various experiments and including children and young people in the interaction. We choose activities that enable active participation of such persons, so that they are not simply passive listeners. This is very important.*

1105. Culture Park of City Fortifications, administrative employee.

It is worth emphasizing that the above-mentioned elements form a part of the NSC premises.

#### **5.1.4. Preparation of the Centre's Employees for Didactic Work**

The basic problem of some of the examined centres is insufficient didactic preparation of employees who undertake the conduct of activities for pupils. Even if, according to the collected material, a significant part of examined professional employees of centres have scientific education, fewer of them are prepared for didactic work with children and young people. In many cases, this results from the fact that didactic work with pupils is an element added to their basic obligations (academic work, technical duties in the centre, work with students, etc.). In particular, this refers to centres operating by scientific facilities (museums, universities, etc.). These insufficiencies have to be supplemented by the interested parties on their own – by participation in training sessions and conferences regarding out-of-school education, references to literature, trial and error, on the basis of own contacts with teachers and methodologists.

*Yet it has to be said that not everybody has a gift for teaching children. Teaching children cannot consist of a lecture. Here, everybody teaches students, but this is something different; when teaching students, you can use such terms that I just mentioned. So when high school pupils come to us, we are simply relaxed, because we do not have to look for the right words, in the sense that we do not have to look for words that will be understood by children. We can use terms from mathematics and physics and they understand us. But with smaller children, there is a problem, because you have to have relevant tools to reach to them. And not everybody is fit for it, some have to learn it.*

102. "Planetarium" Astronomy Didactics and Popularization Division, professional and administrative employee

---

<sup>6</sup> Diorama - a model created with various modelling and art techniques, presenting historical events, nature scenes or urban models. On account of its three-dimensionality, it is an attractive carrier of educational content and is willingly used in museum exhibitions.

An additional impediment is the fact that some centres offer activities for recipients from all educational stages (e.g. from grades 1 – 3 of primary school to high school). This poses additional requirements for employees conducting didactic programmes.

Problems signalled by the respondents result from difficulties with adjusting substantive knowledge to the recipients' perceptive potential and also from differences in the methodology of conducting activities with pupils in comparison to work with students.

#### **5.1.5. Establishing Relations and the Issue of Authority**

The employees of examined entities also indicate that an element hindering the work with pupils is the fact that almost every activity is conducted with a new group of young people. This results in the fact that ability of establishing relation with the youth quickly becomes an important issue. The instructor's integration with young people requires time and skills, which the instructors should possess, irrespective of the effort related to substantive preparation for activities. This requires interpersonal communication skills on the part of the person conducting the activity.

*At the beginning, there is always some sort of resistance; I say something to them and they're just looking around. We have to encourage them to direct participation in such activities, to make everybody touch something, smell something and see something – this is not about me showing them something, but about everybody looking at it in their own way. Later, they are much more willing. When you break this resistance, then later everybody is interested, even in the tiniest details. I tell them some details about the plant's appearance or its smell. The fact that you can walk in the forest and touch every leaf is very important.*

1211. Moravia Gate Arboretum, professional and administrative employee (dyad)

It was also signalled that the arrogant stance expressed by some pupils also poses a certain difficulty for persons conducting the activities. It happens that by their behaviour or statements, the young people indirectly question the substantive preparation of instructors conducting the activity. In spite of the fact that the centres aim at ensuring high quality of offered educational programmes, employing, in majority, persons with relevant education in a specific field who know a given area very well, stances of this type constitute a problem in contacts with pupils. Knowledge about situations of this type is a very strong incentive for thorough preparation for the conduct of activities by the few people who conduct such classes in spite of not being biologists.

*It happens very often that, sometimes for fun, children come to us and say: I will check everything that you say to me because my father is a historian. So I will check it. So, we are not an authority. It is difficult. The children think they know everything. I guess you know it perfectly well and we pay attention to it – they feel at ease outside of the school building. And discipline and involvement of the group cannot rely on the fact that we shout at them. We require obedience from raising our voice and some sort of a regime, but you have to reach out to these children. The activities have to be interactive. Most often, the children that I have disturb and interfere a lot; you have to make them interested. Suddenly, they... You have to trick them, so that they do not realize that they have the knowledge and that something is taught to them. First, they joke, and suddenly, when they are dragged into it, we work on it to make it happen.*

1212. Coal Mining Museum in Zabrze, professional and administrative employee (dyad)

### 5.1.6. Evaluation of Activities by Pupils

The centres usually declare that their offer is prepared with the thought about pupils – for the purpose of stirring their interest in sciences and/ or presentation of resources of a specific facility (a zoological garden, a botanical garden, a museum, etc.). However, opinions of pupils about the offered activities are rarely sought in the form of evaluation questionnaires. Only individual centres perform evaluations of this type (e.g. 107 Environmental Education Centre in Krośnice).

A decisive majority of centres rely on the observations of the group's reactions in the course of activities. The factors that are taken into account include: making the young people involved in performance of individual elements of the programme, overheard comments, private e-mail correspondence with the centre's employees.

*From pupils... We haven't distributed questionnaires among pupils so far. On the other hand, we rely on verbal spontaneous expressions of joy and their willingness to come back here. And also statements like: "I will come back with my mom." Grandchildren, dragging their grandparents during weekends, also provide good evaluation for us.*

*1103. EduPark in Gdańsk, professional and administrative employee*

*There are no such questionnaires which every pupil would get. (...) on the other hand, I often get e-mails from people who participate in such activities and their opinions are recognized in this manner.*

*725. University of Warsaw, Faculty of Physics, administrative employee*

The measure of attractiveness and accuracy of an offer of the centre for young people is also the interest of pupils in making use of its offer individually. It happens that participants of activities return to the centre with a request for assistance in preparation for thematic competitions, writing essays and are willing to participate in activities for individual recipients organized by the centre.

The centres' employees believe that some classes return to the centre on account of interest and needs voiced by pupils (as signalled by the teachers).

## 5.2. Teachers from the Centre's Perspective

According to the respondents, the teachers are interested in cooperation with non-formal science centres – they initiate contacts with centres, participate in selection and adjustment of the programme of activities to the needs of the group.

It is believed that enabling the pupils' contact with a centre on account of its resources, knowledge and skills of persons conducting the activities is very important for the teachers. Many teachers attach importance to extension of educational skills and compensating the insufficiencies of the teaching of sciences at school for pupils (insufficient amount and quality of school aids, no possibility of performing experiments in the classroom, etc.). However, the centres indicate certain difficulties in cooperation with teachers/ supervisors of groups that use their educational offer. This refers to several issues:

- making the teachers interested in participation in activities or making them involved in their course;

- making the teachers interested in tightening educational cooperation with the centre (including preparation of pupils for activities in the centre; independent performance of educational programmes, continuation of activities at school);
- providing the centres with reliable feedback or participation in the evaluation of activities.

### 5.2.1. Two Types of Cooperation

According to the employees of examined centres, two approaches may be distinguished among teachers cooperating with them: teachers involved in cooperation and teachers presenting a withdrawn attitude.

Involved teachers closely cooperate with the centre; sometimes, they consult the content of activity outlines or scenarios, become involved in promoting the centre's offer in the teachers' environment, take active part in the activities as members of groups or offer support for the persons conducting the activities. These are often enthusiasts of their area of specialization or "teachers by vocation" who care about extending the pupils' horizons. Such teachers usually consciously select elements of the centre's programme for their pupils and, apart from their classes, encourage other pupils to participate in the activities, etc.

Meanwhile, as recounted by the respondents, a withdrawn teacher adopts a conservative stance, does not take the risk of becoming involved in cooperation with the centre and does not become involved in the course of activities. After delivering the group to the centre, such teacher assumes the role of a spectator – does not participate in the activities and does not support the person conducting the activities.

*I will tell you this – it happens that teachers take active part in the activities. But it happens in 10% out of 100%. In majority, let's say in 50 – 60%, the teachers help us maintain discipline and we ask for it a lot. 30% are teachers with whom children are unruly and they do not react or simply leave. Such stances happen too.*

*Yes, very rarely, but it happens.*

*It sometimes happens that we get groups without teachers. I do not understand why – this is contrary to the law. But it happens.*

*1210. Earth and Us Association, professional and administrative employee (dyad).*

On the basis of the collected data, it may be concluded that the style of operation of a centre of non-formal education and a school are very different as far as the approach to the presented subjects is concerned, the freedom of extending knowledge and the manner of presenting knowledge. The situations of the teacher and the person conducting the activity in the centre are also different, due to the fact that the latter is not required to verify the knowledge acquired by pupils and is not held accountable for it. The purpose of the centre seems to be making the pupils interested and inspired; schools focus on the transfer of knowledge and its subsequent verification.

The centre is not required to be adjusted to the operation of a school, whereas a school should find justification for using the centre's offer. These differences result in the fact that the teachers are, in comparison to persons conducting the activities, under much greater pressure on the part of the

formal education system. This may, at least partially, explain the passive stance of a great part of teachers described earlier with respect to cooperation with a centre of non-formal education.

*Specifically, this means that... that we simply have hope. That there is freedom of exchange of thoughts. It is not like the person conducting the activities takes place of the teacher who simply comes, says good morning, now we are going to talk about the digestive tract, right? We simply try to make use of the content, because it is often possible, for example in middle school classes. When some of the content may be taken out from them on the basis of what they already know, I do not know from where, most often from commercials or from films? But to simply encourage them to make associations, to combine various things that they have heard somewhere. So it seems to me that we simply have more time, that we do not have to check the attendance, we do not have to verify their knowledge, we have three hours in the case of middle schools and four hours in the case of high schools and we can simply devote more time to this process, we do not have to cover certain subjects from point A to point B, so it seems to me that this is the difference between what happens in the classroom and what happens here.*

703. BioCentre for Science Education, professional and administrative employee

### **5.2.2. Expectations of Centres Regarding Cooperation with Teachers vs. Practice**

From the point of view of centres of non-formal education, optimum cooperation with teachers using the offer for groups of pupils supervised by teachers assumes:

- a. determination of needs of a specific group of pupils and joint, with the centre's employees, selection of a subject of activities;
- b. preparation of pupils for activities in the centre (revising the material from a given subject; introduction of terms; performance of exercises recommended by the centre (if the materials were prepared and made available by the centre);
- c. participation in the activities in the role of the group's supervisor;
- d. independent performance of activities in the centre on the basis of prepared materials and resources (where such potential is available);
- e. continuation of subjects taught in the centre on the basis of materials prepared by the employees of the centre (where such potential is available).

#### **a. Adjustment of the Subject and the Course of Activities to the Group's Needs**

As mentioned before, in the opinion of centre representatives, teachers are more interested in adjusting the course of activities to the needs of pupils with whom they come and they willingly use the centre's flexibility in this respect. Quite frequently, they rely on the suggestions of the centre with respect to selection of a given subject which, in the respondents' opinion, is related to relatively low acquaintance with the centre's offer (especially in situations where there are numerous subjects available for individual educational stages).

Interest of teachers/ recipients in the offer of the centre often results from the positive opinion about such offer circulated through the grapevine or from a positive impression made by an individual educator on the teacher and the pupils.

It is astonishing that representatives of centres notice that teachers often attach slight significance to the content of activities to which they send pupils. In many cases, more important is the fact of visiting a specific centre rather than its offer. It is difficult to justify it by the fact that the teacher's intent is, first of all, improvement of the pupils' skills, thence content would be of secondary importance. Some subjects are selected on purpose and skills are exercised on specific problems. On the other hand, this observation indicates that some teachers attach much less significance to perfecting the skills of scientific reasoning in pupils, focusing on the mastering of skills from the scope of a subject taught to them.

*Either (teachers) select a certain subject and we prepare for it; the person conducting the activity goes to the group earlier - if the teacher selected a different subject we ask him to teach children specific things. The instructor comes out, asks some questions to get his/ her bearing in the situation, it turns out that the group has no idea and this specialist lecture makes no sense and we simply offer a standard lecture. It is interesting that 99% of teachers do not even realize that the lecture was changed. They are informed afterwards and are very surprised. Unfortunately, the level of old teachers is so low. Many laboratory groups come without any preparation. (...) the key to everything is the fact that teachers have to look through the instructions (made available by the centre), see whether they understand them, improve their knowledge and later explain the basic things during school classes. Only then the pupils can see the instructions, come to us and they are fully prepared. Otherwise, this does not make any sense.*

712. National Centre for Nuclear Research, professional and administrative employee

### **b. Preparation of Pupils for Activities in the Centre**

Substantive cooperation between a centre's employee and a teacher is very often difficult. Two important reasons for this state of affairs were identified:

- teachers are not interested and, possibly, sufficiently motivated to prepare themselves and the young people to activities in the centre even if the centre proposes it and offers didactic materials that facilitate it;
- quite often, teachers of subjects other than sciences come with the group – a gymnastics teacher, a Polish language teacher, etc. This happens in cases when a visit at the centre is an element of a school trip or a trip of similar character and not an educational trip within the scope of a specific subject.

The teachers of majors often appear in large cities, in particular in places where the educational offer directly refers to the selected issues of the teaching programme of a specific subject.

Attention was paid multiple times to difficulties in establishing cooperation with teachers with respect to preparation of pupils before activities and following-up the subjects commenced at the centre in schools.

From the point of view of the centres' needs, it would be beneficial if the teachers introduced the pupils to the subject of activities and prepared them, via implementation of specific school subjects or revision of materials. This refers to physics or biology activities. However, this type of support is usually not available.

### **c. Participation of Teachers/ Group Supervisors in Activities**

A significant group of teachers who use the offer of centres stay with their pupils during the activities. However, this often takes place upon a clear request of the centre, which is not interested in assuming complete legal responsibility for the pupils. This also frequently solves the problem of absence of additional personnel to service the activities, which is experienced by many of the examined centres. It is important that the teacher usually only plays the role of a formal group carer, not trying, even if there is such possibility, to become involved in the conduct of activities. For a centre's employee who does not know the children who come and has to devote some time to get to know the group, such assistance on the part of the teacher is also valuable.

In the respondents' opinion, in the majority of cases teachers find it very hard to get out of their school role which assumes a traditional style of teaching (asking questions, statements like: "We talked about it at the last lesson", etc.) and support the centre's employee during the activities.

*What is the situation with teachers? As I understand their presence is conditioned by regulations, right?*

Yes.

*Ola told me that they do not really get involved in the activities?*

Unfortunately, they usually do not.

*Do you think that you are on a completely different planet?*

This is how it seems to me.

*And they do not want to look silly?*

*No, I think that this is the disease of the Polish schools and Polish education that teachers come here and they would like to shove the responsibility onto us for the children during the time that they are here. They do not come here to have classes with them.*

1102. EXPERYMENT Centre of Science, professional employee

*And does it sometimes happen that teachers became involved?*

*No, not really. I guess there are no such expectations, because we would have heard about it or we would have received such opinions. We try to take such opinions into account, especially if the teachers expected that they would be more actively involved in the course of the activities; however, I do not remember hearing such opinions – that they would like it, no.*

1105. Culture Park of City Fortifications, administrative employee.

On the other hand, centres often try to go beyond the school frame of transferring knowledge by focusing on increasing the pupils' cognitive freedom and inciting them to independence and ability to use the knowledge that they already possess. In relation to this, they prefer the teachers not to interfere with the course of activities if they are not prepared and do not cooperate with the centre's employee on the substantive level.

#### **d. Independent Performance of Activities in the Centre by Teachers**

Employees of the examined centres drew attention to relatively slight interest of teachers in the possibility of independent conduct of activities on the basis of resources and educational materials made available in the premises.

Many centres willingly provide educational materials, including ready-made activity scenarios, as well as prepare their exhibitions in a manner that makes independent work with pupils easier for the teachers. In spite of it, it happens very rarely that the teachers use the possibility of conducting classes in the centre's premises, including laboratory classes.

Moreover, in the respondents' opinion, the teachers more willingly use educational paths in a controlled scientific environment (e.g. a botanical garden) than decide to make an independent trip to a more natural (and therefore unforeseeable area) such as a forest, ponds, etc.

Some professional employees of centres believe that the behaviour of teachers shows their anxiety with respect to their sufficient preparation for the conduct of activities in an unknown area and within a scope exceeding the school curriculum. This would be verified if they used the centre's facilities independently.

*We are open to it and we have always been (to the possibility of independent conduct of activities by teachers). And this is what we focused on when building it. It seems to me that this was the intention of building this exhibition; that we would make it available to allow the teachers to conduct activities there. For example: to show children the circulation of water in nature not only by talking, but by coming to such an exhibition to show the model and so on. So that the children can touch it. But unfortunately, this is not used in this way and we regret it a lot, because we would like it if teachers used our exhibition. We even created a special publication to use our exhibition for mathematics classes. This publication is a math booklet; you can measure the walls there, because the hall is quite big. Search for some... some figures hidden on the surface and so on. But, unfortunately, there is no interest in it because teachers would have to get prepared. Nevertheless, we make the materials available. We give away these booklets; every child can get it. You just have to come here.*

1103. EduPark in Gdańsk, professional and administrative employee

#### **e. Follow-up of Subjects Taught in the Centre**

Employees of the examined centres of non-formal education draw attention to low interest, among the teachers, in the possibility of following up subjects taught at the centre. This is evaluated on the basis of interest in didactic materials offered by the centre which could facilitate it. In relation to the above, the centres abandon development of this part of their offer.

#### **5.2.3. Evaluation and Feedback on the Part of Teachers**

Evaluation of activities by teachers is the form of evaluation used most frequently by centres. It tends to be conducted relatively rarely; usually in cases when it is required by a specific project – i.e. conditions for granting co-financing for the implemented programmes.

The majority of examined centres avoid formal evaluations, due to the fact that they are perceived as an additional, labour-consuming procedure, often of little use.

In spite of the fact that evaluation has been an element constantly present in education for approx. a decade, the results of the study suggest that this term is still not fully understandable. It seems that the employees of centres often do not fully understand it; very frequently, questions about evaluation were answered with information regarding feedback; once, the maintained statistics were mentioned. According to the respondents, it is also not understood by the recipients of activities, who make the same mistake. In relation to this, within the scope of the performed evaluations, the centres rarely provided information which would have the nature of a constructive, critical reflection on the centre's offer and its utility for implementation of the school programme.

Most often, information procured in the process of evaluation from teachers is laconic. The answers are often limited to a standard expression of satisfaction with activities ("We liked it a lot", etc.). Such

state of affairs is frustrating for the representatives of centres. This type of evaluation is often considered of “little reliability” and of little use. In relation to this, centres which are not formally required to conduct such evaluation abandon it quickly and willingly. However, there are exceptions where the results of evaluation questionnaires, regarding the substantive level of activities, are used to modify the centre’s offer.

*If the teacher liked it, if he/ she wanted to come back, then it would be silly if he/ she said that it was not fun, so he/ she makes an indirect note about it, but he/ she will definitely not criticize us.*

1110. Gniez Centre for Ecological Information, professional employee

*I think it was two years ago that we prepared a questionnaire within the scope of such programme...*

***This was abandoned – I was told so by the director.***

*Yes, it was abandoned. However, we collected quite a few of such questionnaires. Some of them were examined by us, teachers. I will be honest; there were no expectations in these questionnaires with respect to the programme or some new subjects. Expanding the offer. Most often, the teachers wrote: it was fun, more activities of this type, and so on. (...) This was not good for us because this was not what we were expecting.*

209. Zoobotanical Garden in Toruń, professional employee

All centres attach importance to feedback provided by teachers in the course of and after activities. It is declared that positive comments are a majority, even though there are also suggestions regarding changes in the manner of implementing selected issues, which are usually taken into account when the centre’s offer is changed. It happens that such remarks reach the centre immediately after the activities, but are also sought in the course of meetings, at educational conferences, etc. Positive feedback, combined with significant interest in the centre’s offer, is very often presented by the respondents as an argument justifying resignation from formal evaluation (“*why bother with it if everything is all right?*”).

***Do you collect feedback, do you evaluate the activities?***

*Unfortunately not; evaluations were prepared from time to time, within the scope of various M.A. or B.A. theses that were written here, on the basis of resources of our museum. In such cases, such persons conducted the questionnaires for a month or longer, as required by the thesis methodology. We, unfortunately, do not conduct such studies on an ongoing basis.*

606. Municipal Engineering Museum in Cracow, administrative employee

#### **5.2.4. Activities of Centres Focused on Support for Teachers**

Employees of examined centres often declare that their offer is mainly focused on the needs of pupils and not teachers. However, the results allow for identification of several important types of activities focused on provision of support for the science teachers.

They are implemented via:

- conduct of methodological trainings for teachers;

- conduct of practical training sessions, e.g. showing the manner in which selected experiments listed in the NSC should be performed;
- encouraging teachers to participate in activities, to make them inspired and to show efficient manners of working with young people or to make them acquainted with manners of conducting science classes in a given environment for which the centre makes didactic materials available (e.g. a botanical garden, a reserve, etc.);
- making didactic materials available for independent implementation of selected subjects by the teacher both at school and in the centre;
- participation in conferences attended by teachers.

The persons conducting activities have noted that sometimes not only pupils, but also teachers are characterized by a deficit of practical knowledge in major fields, for example biologists have difficulties with recognizing plants or animals in the forest and physicists have troubles with independent performance of experiments required by the NSC.

*For example, I had a teacher once... I do not know what she taught... She was sitting at the back. In Ruda. And I am explaining bio-cenosis and talking about trees. And she had these scared expression on her face...*

*1210. Earth and Us Association, professional and administrative employee (dyad)*

Employees of centres which, apart from activities for pupils, also perform methodological training sessions for teachers, notice that teachers also have certain difficulties with transferring knowledge in a practical manner.

*Later, we included activities in workshops that were aimed at helping schools that are struggling with difficulties. Both with equipment and also with lack of personnel. These teachers, very young teachers, who work at schools often need preparation to perform the experiments proposed in the new reform. And I have to say that when I see the fear of teachers to teach circuits, to check the gauge I wonder how they could conduct classes without being afraid. Because teachers cannot show that they cannot do something. They should be able to do everything. They should know much more and move in this area with greater ease than pupils. Thence, we wanted to help the teachers.*

*725. Faculty of Physics, University of Warsaw, professional employee.*

*Yes, we have programmes for teachers, there used to be this activity called Edu People, we performed it in cooperation with Swedes. These were specific workshops for teachers. These were not lectures that teachers would listen to and then wait for a certificate. These were workshops at which these teachers sat in groups and had to perform experiments.*

*1102. EXPERYMENT Centre of Science, professional employee.*

In relation to the above, participation of teachers in activities performed by the centre tends to be, from the point of view of its employees, a good opportunity for making the teachers acquainted with manners of teaching specific subjects or manners of performing experiments required by the NSC.

Centres which are not directly interested in adjusting their offer to the NSC provisions and take the NSC into account only indirectly, also drew attention to the possibility of providing support for teachers in development of skills of teaching sciences to pupils thanks to careful participation in activities.

The centres want to share the manners of working with young people developed by them within the scope of sciences and the manners of improving skills related to them. This seems to be equally important for the professional employees of centres as for drawing inspiration or obtaining consultations within the scope of shaping of the centre's offer from active teachers who are interested in this type of intellectual exchange.

### **5.3. Schools from the Centre's Perspective**

The attitude of the examined centres to schools is much diversified. There are both centres closely related to schools and cooperating with them on multiple levels, and centres that are strongly distanced from schools.

#### **5.3.1. Adjustment of the Centre's Offer to School Needs**

Some centres closely cooperate with schools and methodologists in preparing their educational programme. Most often, these are centres created together with teachers/ practitioners, including university teachers and centres that were established in large cities as educational units by various types of institutions, e.g. museums, as well as commercial centres. This is the case because in principle, their operation is aimed at direct support and supplementation of the school curriculum within the scope of science education and sometimes also support for teachers in implementation of the curriculum.

This was the manner in which educational programmes for groups of pupils supervised by teachers were constructed, in particular in two types of centres: these which want to increase the interest in their facilities via cooperation with schools (e.g. museums) and these which aim at establishing or improving the relations of the centre with the local community (e.g. National Parks).

Some centres are established or extend their statutory operation onto educational activities for children and young people being convinced that the school offer is insufficient – both with respect to the scope of material and reliability and methods of its presentation (teaching without references to practice, presenting the subjects in a shallow manner, etc.).

#### **5.3.2. School Stereotype**

The employees of examined centres often perceive the school as an imperfect institution; it is associated with a boring style of teaching, focused on transfer of theoretical knowledge. Meanwhile, to make the pupils interested in sciences and to efficiently transfer the knowledge and develop their skills, the possibility of observing and experiencing phenomena from the scope of sciences is necessary in the opinion of centre representatives. Centres that have been conducting educational activity over a longer period of time and offer activities for pupils in various ages, pay attention to two issues:

- first of all, it is said that at lower stages of education, pupils are more open and more interested in active participation in activities and greater absorbency of knowledge. It is believed that this is the result of socialization of children at further stages of education to the

“school” manner of thinking and learning, which limits the natural curiosity and cognitive absorbency;

- secondly, attention was drawn to the fact that in the course of years, children at specific educational stages who come to centres have more and more limited knowledge from the area of sciences. Employees of the examined centres formulated an opinion that this is a result of changes in the curricula.

### **5.3.3. System of Limitations**

In the opinion of centre representatives, requirements imposed by the current legal system onto teachers with respect to the possibilities of having classes outside the school area create a significant problem.

Attention is drawn to the fact that they become, more and more frequently, a barrier in using the offer of non-formal education, as the number of conditions with which the programme and the teachers have to comply is increasing. Some representatives of examined centres are afraid that tightening these criteria may lead, in a longer period of time, to the necessity of significant limitation of educational activity and even resignation from this part of the offer (such fears were voiced in centre No. 606 the Municipal Engineering Museum in Cracow and centre No. 1212 the Coal Mining Museum in Zabrze).

*Even more so that - as you probably are well aware of - at this moment there is such tightening of regulations that a teacher's outing with children during classes to another institution than the school has to have strong arguments to make the headmaster and the parents approve it. Everybody (museum employees and other cultural institutions) is struggling with the problem of a decreasing number of visitors. The regulations are so tight that the children cannot go. So the offer has to be sufficiently attractive to make them come. This cannot be a random thing. So we have to stand on our heads to make the activities on a high level and to make the pupils come here, because practical activities and museum visits take place in the afternoons and during weekends. These are the additional hours that the teachers have to work out. So that is why our activities have to be of high quality.*

*1212. Coal Mining Museum in Zabrze, professional and administrative employee (dyad)*

The respondents also devote a lot of attention to the changes which are going to be introduced soon in the teaching of sciences in secondary schools. They are evaluated as a step in the wrong direction for pupils, schools and centres of non-formal education. It is believed that such changes might limit the possibilities of modifying, by young people, decisions with respect to further education due to the fact that supplementing the extended material of classes with a specific profile will be very difficult. Apart from it, this will be an opportunity for further limitation of the scope of the material, and thence making the knowledge of an average graduate of a secondary school even more superficial, which will translate into adult life of such pupils.

### **5.3.4. Teaching Style of Centres In Comparison to Schools**

The examined centres, directly or indirectly, aim for teaching “differently than the school.” Often, this means showing that scientific items are interesting and also that learning is a fascinating activity and may take place in a completely different way than at school.

Thence, during the activities, attention is drawn to:

- informal atmosphere during activities, which is conducive to exchange of thoughts and ideas between the person conducting the activity and the participants (often determined as a dialogue, conversation between the person conducting the activity and the participants);
- making references to the knowledge possessed by pupils and encouraging them to take the role of authority – presenting to the rest of the group the information that they know;
- enabling free movement in the classroom/ exhibition/ area where the activities are conducted;
- possibility of touching the exhibits/ items/ tools with which they work and to experience the world of nature with all senses (e.g. hearing, taste, smell);
- encouraging independence – both as far as performance of experiments is concerned and drawing conclusions from the conducted observations;

*Children should be allowed to do things on their own. Have you seen the textbooks that they have these days? They have changed so much in the course of the last 10 years, they are so interesting. When you do something experimentally in the class, when the pupils like it and see the associations, there is no boredom. But everything has to be presented in the right way.*

216. *Small Scale Chemistry Centre, professional and administrative employee*

- the centres try to invite small groups of pupils and in the case of laboratory activities, pupils are additionally divided into small teams (2 – 5 persons).

*We are trying to approach issues in a practical manner. And our entire ecological education goes in this direction; obviously, we think globally – how beautiful our planet is going to be. But we are teaching small, every-day things. And this is what we teach here. For example, what my colleague said about the garbage. So in principle, what we can do in our every-day life, in our households, in order to protect nature. In various aspects. The issue of garbage that we are finishing now; we have not yet finished with the garbage or the protection of trees in cities that we do now or, potentially, getting to know the nature in your closest vicinity. We start with an assumption that... Because the important element of these activities is the so-called emotional acquaintance with nature. Along the principle: if I like something, I protect it.*

1210. *Earth and Us Association, professional and administrative employee (dyad)*

In spite of the fact that the centres often indicate the above elements as distinguishing their offer from school teaching, the above listed practices and assumptions are, in principle, consistent with the definition of best practices adopted in the study and related to the NSC.

The talks with professional employees of centres often feature the theme of educating by instilling with passion and involvement. This is achieved by involving enthusiasts and experts in specific areas to work with young people (biologists, chemists, beekeepers, mineralogists, forest officers, etc.). Some of them are regular teachers or professional employees of centres, whereas others are persons employed for specific periods or for the conduct of individual types of activities. Due to the fact that such people deal with the issues to which the activities are devoted to professionally or on a day-to-day basis, they often provide a very valuable source of knowledge about their areas of specialization. Employees of centres draw attention to the fact that competences of instructors and confidence that results from it very often facilitate work with children due to the fact that such people instil greater respect among young people and often intrigue them.

*Sometimes, we ask people who care for the animals to help us and they have more extensive knowledge than us (...) they also use the opportunity and can talk about the animals and share things about which we often have no idea. And this makes the activities even more interesting. When we know that there is such demand, that it is a high school group preparing for the final exams, then we can also ask other employees to help us and to support our work, to tell more interesting things about animals. This is good motivation when a group (of almost graduates) comes and they see a man who is just a bit older than them and who works in the zoo and talks with enthusiasm about his work, about animals and this mobilizes them to move in a certain direction later.*

*113. ZOO in Wrocław, administrative and professional employee (dyad)*

### **5.3.5. Influence of the Age of Recipients on the Centre's Operation**

In the opinion of representatives of examined centres, the most rewarding and cooperating recipients of offered activities are preschool groups and primary school pupils, in particular grades 1 – 3. It is believed that at this age, children are still very spontaneous and express their interest and, at the same time, they do not feel such a great pressure of the group and are not afraid of embarrassment on account of lack of knowledge and cognitive naivety as in later age. In relation to this, it is easier to make them interested and involved in the programmes offered by the centres.

Therefore, most difficult recipients of activities, according to the employees of centres for groups of pupils supervised by teachers, are middle school pupils. It is difficult to reach to them, establish a relation and induce them to cooperation. There is also an opinion that older youth is “more contaminated” with school, i.e. more used to the school standards of behaviour, teaching and thinking, including schematic thinking.

*Even middle school pupils come to these classes and they are willing to cooperate.*

***And this is not so obvious, as I understand.***

*No, it seems to me that this is not obvious. When middle school pupils come, and you do not make them interested, then, first of all, they will try to find out how to leave this place – a side exit, an exit for the personnel or even through a chimney. This is a specific age group – they want to show off and if one of them behaves like a daredevil, the rest will behave in the same way. Dealing with them is difficult. And I think that this is really a huge success of such activities that I had a group only once that did not want to cooperate. And they really wanted to leave as soon as possible, because not everybody liked it.*

*1102. EXPERYMENT Centre of Science, professional employee*

On the secondary level, the majority of examined centres encounter general secondary school pupils. Slight interest in the offer of examined centres on the part of technical high schools was mentioned. It is believed that this mainly results from limitation of the number of hours of science subjects in the curricula of schools of this type and attaching lesser importance to the general education of pupils, especially if it was at the cost of time assigned to the vocational teaching.

It was also signalled that the higher the educational stage, the more difficult it is to encourage to more intense use of the offer of examined centres.

### 5.3.6. Activities of Centres Oriented Towards Support for Schools

Employees of examined centres of non-formal education signalled undertaking a number of activities aimed at supporting schools in the possibility of using their didactic offer. The following activities were indicated:

- activities aimed at eliminating the financial barrier which is, for many schools, the necessity of paying for activities or costs of transporting the pupils to the centre.
  - decrease or annulment of the fee for activities at the school's request is a frequent practice;
  - the centres try to procure funds from local or regional resources for co-financing selected educational programmes in order to minimize fees for local recipients (this is particularly important on the level of rural and less affluent poviats);
  - some centres also try to procure or assign funds from their own resources for co-financing pupils' transport from school to the activities.
- direct interest in supporting schools in implementation of the NSC requirements regarding the teaching of sciences. This is implemented in cooperation with methodologists from the board of education and a group of teachers from schools interested in cooperation:
  - it is interesting to note that the particularly efficient method of meeting this objective are annual competitions for pupils performed in cooperation with teachers. The idea of the competition is to follow the curricula of individual subjects and to support pupils and teachers in systematic acquisition and solidification of selected skills (1101 Centre of Ecological Information and Education); inspire pupils to exploration of issues from the area of ecology using examples from their immediate environment (1210 "Earth and Us" Association);
  - some centres offer activities which allow for the teaching of individual subjects included in the school curriculum at specific educational stages (725 Faculty of Physics, University of Warsaw);
- limiting the duration of activities to 45 minutes for the purpose of adjusting to the needs of schools and limitations related to the conduct of activities outside the school (723 Museum of Technology, 606 Municipal Engineering Museum in Cracow);
- offering the groups a longer stay in the centre by ensuring accommodation for school trips, encountered in some centres located in the peripheries or in the vicinity of protected areas. The offer of such centres becomes more attractive for schools located at a significant distance, for which a trip to individual activities would be too costly (time and finances).

## 5.4. NSC from the Centre's Perspective

### 5.4.1. Understanding the NSC by Centres

The centres take the NSC into account when constructing the educational offer for pupils supervised by teachers. It is interesting to note that only some of them do it consciously and refer to the document

of 2008. A significant group declares that it does not take the NSC into account when preparing the offer, yet becomes acquainted with the content of school textbooks from the last 3 – 4 years.

According to the statement above, we encounter two types of stances with respect to the NSC:

- some centres purposefully adjust their offer to the NSC of 2008 thinking about support for teachers in teaching individual subjects or experiments from its scope;

*Is support for teachers also an element of your offer? Or do you think more about pupils?*

*Definitely the teachers, especially due to the fact that we invite pupils, yet teachers implement a part of their curriculum thanks to activities in our centre.*

*The subjects that we cover here are included in the school curriculum. We extend them, revise them, supplement them and, potentially, teach them in the form in which teachers are unable to teach them.*

*102. "Planetarium" Astronomy Didactics and Popularization Division, professional and administrative employee*

- some centres are not interested in the NSC in spite of having knowledge from the area of educational requirements at relevant teaching levels for their educational offer.

Talks with employees of centres indicate that the NSC is very often treated by such centres not as guidelines regarding the manner of teaching and a collection of methodological recommendations, but as a framework of curriculum requirements. In other words, the centres are interested in the NSC in order to become acquainted with the expected level of knowledge of pupils at individual teaching stages and the range of terms that they are able to use and which are understandable for them. Therefore, it may be concluded that centres are interested mainly in the teaching content and not teaching objectives. Centres need this knowledge in order to adjust their own programmes and prepared activities to the cognitive potential of recipients and to evaluate the range in which their proposals go beyond the school's offer.

For a significant part of the examined centres, the area for supporting the implementation of the NSC by schools is not the offer of activities for pupils supervised by teachers, but other types of educational activities.

Some centres are involved in implementation of a number of competitions for pupils. These types of programmes co-created with teachers and methodologists are aimed at developing skills from the area of requirements of the NSC (e.g. independent performance of experiments, scientific thinking, formulation of conclusions, etc.) in cooperation with the school. This means that pupils may participate in them as representatives of schools supervised by their teachers. Projects of this type have various forms. An example may be provided by the programme "Forge of Nature Researchers" where, during cyclical activities (out-of-school), school youth learns research methods in sciences (centre 1104, Eco-Initiative Association).

Other centres put a lot of emphasis on work with teachers. In such a case, a very important area of a centre's operation is training teachers and working with them for the purpose of improving didactic skills and fluency in implementation of experiments and methods of working with young people recommended by the NSC. Some centres from this group prepare additional training materials and/ or didactic sets which are meant to facilitate implementation of specific experiments for the teachers during school classes (e.g. centre 703 BioCentre for Science Education; centre 1103 EduPark; centre 1225, Faculty of Physics of the University of Silesia).

*Maybe not books; in a project we once described several experiments. Such project initially had the aim of teaching the teachers, who could later use such experiments during their classes. We know that teachers use them, because these were simple experiments which could be performed with pupils. By going to festivals of sciences or looking at photos that teachers send, we know that this is really implemented. It appears in many schools and young people really perform these experiments that we suggested or described as examples.*

*1225. Physics Didactics Division at the University of Silesia, professional employee*

#### **5.4.2. Educational Aspirations of Centres**

Irrespective of the fact whether operation of a centre focuses on cooperation with schools or whether out-of-school education constitutes only an additional area of its operation, general objectives of the examined centres are similar.

Representatives of both approaches to the NSC unanimously declare that they are not interested in relieving the school from its educational tasks. However, they try to:

- inspire the pupils' interest in selected sciences;
- extend the pupils' knowledge beyond the school offer and systematize the information held by pupils;
- break erroneous convictions regarding the natural world (e.g. storks eat frogs, only people are responsible for the greenhouse effect, etc.);
- show the world of nature as a complex whole which may be analysed and examined from various perspectives;
- break the negative stereotypes about individual school subjects (e.g. physics is difficult and boring).

*These children ask questions. They are curious. They are very interested. Sometimes, a group comes and we can say that they are 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> graders and they cannot distinguish a stag from a roe deer (...). And when they are with us, they learn so many important things. And, at the same time, they solidify the knowledge that they acquired at school. Teachers also see that this makes sense, because they often tell us so. New things and interesting things are always attractive.*

*1219. Representative Bison Pen, professional employee*

as well as to:

- show various disciplines of sciences as interesting and, at the same time, useful from the point of view of everyday life (e.g. how to use the ability of distinguishing plants);

*I hope that after every visit, something new will open in such young people. Some new look, some thought. I hope that they will start seeing more around them and that they will start to look at the sky and see the things that we talked about. But also general thoughts, because astronomy is an area of science bordering upon philosophy. Anyway, this division into sciences is currently artificial. In the past, astronomy was the proper science.*

*It encompassed philosophy, mathematics, physics, chemistry, everything. So if somebody is interested in astronomy, their horizons are so extensive that they can go in any direction. We want to make them sensitive enough to take notice, to start thinking and asking questions.*

102. "Planetarium" Astronomy Didactics and Popularization Division, professional and administrative employee

- bring the local nature/ natural, cultural and social resources closer in the context of science education;
- show the place and the role of people in this system;
- enable direct experiences for pupils.

It is worth noticing that some of these aspirations coincide with general requirements of sciences contained in the NSC, which means that there is an area of common objectives between schools and centres of non-formal education.

#### **5.4.3. Performance of Activities**

In many cases, centres of non-formal education successfully extend the duration of activities or thematic blocks beyond a school class (45 minutes) or even an hour. The possibility of offering such educational programmes depends on the preferences of cooperating schools. In municipal centres – closely cooperating with schools that are interested in the offer that could be incorporated into other classes – the activities are usually standardized with school requirements and last 45 minutes. Quite a common solution is the optional offer of combining two activities into a block of 1.5 hours (e.g. a museum class and visit at the museum).

Centres located in the peripheries and having natural resources at their disposal (e.g. a National Park, a complex of ponds), more often include activities in the form of cycles or field trips in their offer. In such cases, classes range from 2 to 5 hours. Employees of centres believe that work in extended educational blocks is beneficial and does well in practice. This allows for greater diversification of work methods used in the course of one block and also gives more time for independent work of pupils (e.g. collecting natural materials, performance of chemical analyses, describing the performed experiments in worksheets, etc.).

### **5.5. Local Community from the Centre's Perspective**

From the point of view of the examined centres, local communities are important partners. Areas indicated as particularly important in such relations include:

- cooperation with local institutions and organizations;
- place and manner of performance of activities from the centre's offer;
- conflicts regarding protected areas;
- consequences of devastation of the natural environment.

### 5.5.1. Cooperation with Local Institutions and Organizations

An important aspect of functioning of the examined centres is cooperation among organizations and institutions from the local level, dealing with science, environmental protection and economy. Use of such contacts allows for diversification of the educational offer of centres, making it more attractive, as well as it indirectly contributes to integration of the local community.

Activities of this type turn out to be particularly useful during implementation of long-term or cyclical educational projects (e.g. centre 1228 “Forge” in Rybnik; centre 1212 Coal Mining Museum in Zabrze). This also facilitates creation of educational offers lasting a few days, consisting mainly of several didactic blocks (e.g. 107 Environmental Education Centre in Krośnice).

*First of all, we (cooperate) with the Lublin Ornithological Society, with which we procure funds together. (...) we have professional, qualified ornithologists who perform activities and conduct the ornithological workshop.*

*370. Nature Museum in Kazimierz Dolny, professional and administrative employee (dyad)*

### 5.5.2. Place and Manner of Performance of Activities

Many of the examined centres, apart from the offer in their own premises, offer the recipients the possibility of organizing educational programmes at school. Usually, the persons conducting the activities come to schools on their own; sometimes, the cost of transport is reimbursed by the facility that is visited. Such offer tends to be, in particular for pupils from small, peripheral places, the only possibility of using this type of educational activities, due to the fact that costs related to transporting the children to the centre exceed the financial possibilities of their parents and the school. It seems that many of the examined centres perceive the necessity of such activities. In this respect, the centres show significant flexibility and perceive the importance of such solution. Employees of the examined centres also drew attention to the fact that the educational offer in schools solves the problem of excusing the pupils from other classes in order to make it possible for them to come to a centre.

In spite of the attractiveness of such solution, it is an important issue for the school that a similar method of work partially limits the potential of the centre’s employees as far as work methods or the resources used are concerned. Transferring the activities of the centre to schools also makes going beyond the school context more difficult and shows the limitations entailed by it (it is difficult to offer non-formal education in a “formal” environment which, in principle, influences relations between interaction participants).

The implemented study also allows for indicating an interesting practice applied by some centres within the scope of their educational offer. Such practice consists in making attempts at breaking the conventional thinking about science education by showing that it is possible to conduct it and that it may be attractive and innovative also in contexts perceived commonly as “anti-scientific” (e.g. the project “Ecology in the City” implemented by centre 1210 “Earth and Us” Association from Dąbrowa Górnicza).

### 5.5.3. Conflicts Regarding Protected Areas

Centres whose basic task is taking care of the natural protected area (National Parks, reserves, forest inspectorates) indicate that limitations that result from it for the local community tend to be a source of conflicts and often aversion towards the centre. In such situations, the educational offer related to the

above-mentioned resources tends to be constructed as a form of building relations with the local inhabitants. Such idea usually constitutes an additional element in educational activities, next to the statutory task of promoting and making the protected area available to the society at large. The important themes in science education include:

- promoting the scientific value of a given place and breaking negative stereotypes related to environmental protection (e.g. perceiving it only in terms of limitations);
- the so-called “grassroots education of the local community” i.e. reaching to it via its youngest members who instill the ideas related to environmental protection in a relatively neutral manner from the point of view of local inhabitants.

Usually, within the scope of own funds or co-financing procured regionally, centres offer some activities free-of-charge to schools located in direct vicinity of a protected area (e.g. from communes adjoining the Roztocze National Park). Employees of centres perceive positive results of such activities, both as far as mitigation of negative stances with respect to a centre is concerned and the impact on the local perception of the problem of nature protection.

*(...) truthfully, you know, one thing seems sad to me. The adjoining commune of Cyców is proud that they have the Polesie National Park close by, whereas our commune...*

#### **Where the National Park is located?**

*Yes, the Park is located in the majority of the area of the Urszulin commune and the commune does not seem to be happy about it. We try to reach to the local community in various ways. We are becoming more and more successful. Even though, as I say, certain bans and certain conflicts of interests between the Park and the people will always be present. We do not have such conflicts as in other parks, but in many cases you have to explain it to the people that it was not the budget that built a specific building and that this is not at the cost of a hospital but that these are funds from the National Fund for Protection of Environment and this money only goes to such purposes. For environmental protection purposes.*

301. Polesie National Park, administrative employee

#### **5.5.4. Consequences of Devastation of the Natural Environment**

A completely different case is a situation, particularly noticeable in Silesia, where the educational activity of interest to us is an element of activities that are aimed for compensating the damages of the natural environment for the local community, resulting from its intense exploitation.

These are situations when, e.g. institutions related to industry, responsible for damages in the local environment, co-finance the educational science offer, addressed to pupils supervised by teachers (e.g. centre 1212 Coal Mining Museum in Zabrze, centre 1228 “Forge” in Rybnik).

*There is one institution here, I think it is called Cultural and Sports Association, “Forge.” This is a unit that was established by the Rybnik Power Plant, this is our largest industrial plant. Unfortunately, this is a conventional power plant, but it has its ambitions of going in the direction of social activities and it is developing intensely.*

1228. “Forge” in Rybnik, professional and administrative employee

Educational programmes created in this manner are implemented in various forms – as far as duration, cyclical nature and target groups are concerned. It is characteristic to note that they are characterized by significant eclectics of subjects and areas that are covered; for example, they combine the elements of ecology, history of the region and selected school subjects (e.g. geography, biology and others).

## 5.6. Sources of Financing of Educational Activity of Centres

### 5.6.1. Used Sources of Financing

Sources of financing the operation of examined centres are varied and depend, in a significant degree, on the legal status of entities. Two main tendencies may be indicated.

Centres operating within the framework of budget units (e.g. scientific centres, museums) are, to a large degree, financed within the scope of statutory funds, from which wages of full-time employees are paid, along with costs of exploitation of buildings/ rooms. In many cases, fees are collected for activities conducted for pupils supervised by teachers. The obtained funds are usually assigned for ongoing expenses, i.e. purchase of reagents, remuneration for persons employed upon commission who conduct activities. In the case of some centres, such funds go to the “joint account” of the institution within whose framework educational activity is conducted (e.g. centre 1225 Faculty of Physics at the University of Silesia); in such cases, it is difficult to indicate directly the manner of their management.

EU funds are also used. However, it seems that centres are not proficient in applying for this type of co-financing. More often, it is easier to obtain co-financing from funds for purposes related to extension and equipment of centres or sports and accommodation facilities rather than educational programmes. A frequent barrier is lack of familiarity with the procedures, lack of experience in writing applications and, often, the legal form of centres which introduces limitations or increases the required amount of own contribution to the project to a level that is too high, in reference to the potential of the centre.

#### *And do you try to use the EU projects?*

*We have tried, but you know, we participate in many projects as sub-contractors; we have not been an independent applicant yet, because we do not have courage and time for it. There is so much work that we do not have time.*

216. *Small Scale Chemistry Centre, professional and administrative employee (dyad)*

Funds from the NFPEWM and the VFPEWM are used successfully and on a large scale; they are usually not treated as EU funds by centres. Almost every of the examined centres procured funds for selected educational projects from these resources. They are also used to finance scientific aids, exhibitions, dioramas and other elements of equipment and facilities, for the benefit of activities for pupils supervised by teachers that are conducted by such centres.

#### *What are your sources of co-financing?*

*The Voivodeship Fund for Environmental Protection helped us with the equipment; they also helped us financially – i.e. caring for trees (...).*

***Where do you get funds for workshops for children?***

*From the National Fund for Environmental Protection (...), also the National Fund covers all costs related to workshops; it co-finances my pay, because I am involved in organization tasks, as well as the accountant's pay and pay of various persons that are involved. All of this helps us acquire funds for operation of the entire company.*

*1219. Representative Bison Pen, administrative employee*

Some centres successfully apply for co-financing of selected programmes to communes and units of local government, mainly commune offices. Usually, the procured funds enable abolishment of fees for activities for children from the area of operation of a given unit.

*We are also trying to procure subsidies for our operation. Mainly, this is the National Fund for Protection of Environment and Water Management and the Voivodeship Fund for Protection of Environment and Water Management. These two funds support us to a large degree.*

*And there is also co-financing from the City Office and the Commune (...). The City Office orders activities for specific groups of children and we perform them.*

*1114. Gdynia Aquarium, professional and administrative employee (dyad)*

Definitely, centres with unclear legal form are in the most difficult situation (e.g. the Breeding Workshop at centre 4062, Nature Museum in Zielona Góra), which limits or hinders independent application for funds. A way for overcoming this type of limitation is to establish an association, enter into cooperation with local government units or educational units with a regulated legal form. In many cases such solutions are used, yet in spite of it, some respondents declared that they encounter significant difficulties as far as skills and knowledge in this respect are concerned.

Centres for which conduct of educational activity goes beyond the main objectives of operation, encounter a barrier in procurement of funds for educational programmes. This results from the fact that the system prefers units dedicated to education when distributing the available resources, irrespective of the obtained educational effects and interest in the offer (cf. centre 606, Municipal Engineering Museum in Cracow).

It is worth noting that units embedded in the higher education system indirectly co-finance the programmes conducted by them in the area of non-formal science education from funds deriving from scientific grants (e.g. by using, in the course of activities, equipment purchased from a grant, etc.).

It is possible to notice the centres' sensitivity to the financial potential of schools – many centres make their offer available free of charge if the schools apply for it (e.g. in the case of schools from poorer areas, communes, etc. for groups of disabled persons). Moreover, some centres try to procure funds to co-finance transport of children for activities (from subsidies or own financial reserves). Attention was drawn to the fact that that this is often a problem due to procedural issues.

***How do you evaluate this amount? Did it happen that it was a barrier for the participants or have you not heard comments of this type?***

*Yes, there were such comments that it may be a barrier, but if it is a barrier and we are informed that it is a barrier, we have the possibility of exempting a specific percentage of pupils from the group from this fee. The schools willingly use this opportunity and sometimes the entire group may not be required to pay. We have such schools, not only schools, because there are also kindergartens that come here and also some institutions that already know that they will be exempt from payment, and they apply for it and do not have to pay.*

*1225. Physics Didactics Division, University of Silesia, administrative employee*

### **5.6.2. Voluntary Service**

Small part of centres regularly uses voluntary services of external persons (e.g. students or local inhabitants). In spite of it, voluntary service is the main form of work for the centres. This is the case because, in line with the conducted interviews, a significant part of educational activity conducted by centres relies on personal involvement of employees. In particular, this refers to the time devoted for preparation of activities, including preparation of didactic aids, indispensable for their implementation (e.g. construction of a planetarium by employees of centre 102, the Wrocław Planetarium).

## **5.7. Conclusions and Recommendations**

According to the quality study, the picture of non-formal science education may be described in three words: passion, holism, practice.

- passion and involvement of centres' employees is their most important capital and, in a significant degree, determine the success of undertaken activities, including educational activities addressed to pupils supervised by teachers;
- a holistic outlook on sciences and teaching them "in the context", by showing cause-and-effect relations is the main didactic element, distinguishing the manner of teaching of centres from the teaching at schools;
- aiming for experiencing the acquired knowledge in practice and using the acquired skills allows for perceiving elements of science in every-day life and in every-day applications. This purpose is very high among priorities of centres (it is also consistent with the NSC guidelines).

Centres of non-formal science education are frequently involved in cooperation with schools. However, the aspiration of some centres is "to teach differently than schools" i.e. to go away, on various levels, from classic school methods, such as, e.g., conduct of "lectures in the classroom", not supported by display of practical application of knowledge.

The NSC is the point of reference in the shaping of programmes, but it is often treated as a framework for the scope of material required at individual teaching cycles. The NSC is relatively little known and rarely taken into account during preparation of educational programmes of centres.

Employees of examined centres perceive difficulties that may be encountered by teachers with respect to the teaching of sciences at schools. This refers both to the issues related to changes in school programmes (change in the scope of material, content of teaching), as well as the possibility of practical implementation of some of the recommendations of the NSC and practical preparation of teachers for their implementation. In relation to this, apart from the offer addressed directly to pupils, a significant part of centres also prepares an offer addressed to teachers.

However, it seems that on the part of the system of education, sufficient motivation and encouragement is missing to increase the teachers' and the schools' involvement in cooperation with non-formal education centres.

The results of the study allow for formulation of a hypothesis that the relation of the system of formal education to the offer of the examined centres is ambiguous. The same centres are sometimes treated as centres of professional education and a source of support for schools and sometimes as suppliers of recreational and entertainment offer. In relation to this, the reasons on the basis of which pupils are permitted to participate in activities offered by the centres, and thence the definition of the situation for the pupils and the teachers participating in the activities are very different. It may be expected that this influences the involvement of pupils and teachers in activities and therefore the level of using the centre's offer and the real impact of the centre's operation on the degree and efficiency of implementation of the NSC by teachers.

Among strong points of centres, it is necessary to indicate:

- involvement of employees, readiness to devote their own free time to the idea of showing sciences and nature as beautiful, fascinating and useful;
- good cooperation on the local level (with the commune, the school, the board of education, the public benefit organizations, etc.); this refers to many issues: from promotion in the region, via joint applications for financing of projects, mutual inspiration and others;
- institutional anchoring – support of an institution that may provide premises, administrative, financial and intellectual resources;
- ability to procure sources of financing and management of possessed funds (also for the purpose of obtaining funding in the future).

Among weak points of centres and barriers hindering their operation, it is necessary to indicate:

- law and limitations related to it – legal limitations influence the possibilities of using funds dedicated to the conduct of educational activity;
- unstable legal form, which limits the possibility of using the existing systems of support (e.g. application for funds) or places the centre outside the interest of institutions related to education;
- absence of support and cooperation on the local level;
- absence of fixed funds for ongoing operation;
- deficit of personnel, including, in particular, teachers cooperating on a regular basis.

#### **5.7.1. Recommendations for the Formal Education System**

In order to improve efficiency of cooperation of non-formal science education centres with the formal system of education, it may be useful to consider the following activities:

- to take the centres into account in the NSC requirements (currently, the recommendations regarding implementation of activities from the area of sciences do not indicate them straightforwardly) or aim for increase in efficiency of informing principals and teachers about a possibility of implementing the NSC recommendations regarding conduct of activities from the area of science education outside the school with the support of centres;
  - visits at centres of non-formal education could be indicated among requirements imposed on the school and the teachers by the curriculum;
  - this may be performed in the form of a list of centres recommended as places for activities held outside of schools. Entering a centre to the list of recommended centres could be related to requirements regarding the offer (e.g. controlled by the Ministry of National Education) and benefits in the form of co-financing, advertisement, certificates, etc.;
  - to create a database – a portal presenting the basic information about centres of non-formal education with a possibility of browsing it according to selected criteria – e.g. location, school subjects supported by activities, scope of curriculum content, skills developed during activities, etc.;
  - both schools and centres could use such portal. The offer of the portal could be extended onto catalogues of best practices within the area of education, experience exchange platform, possibility of offer synchronization, creation of broader programmes, etc.;
- to strengthen the incentive system which will encourage the teachers to fuller use of the offer of centres of non-formal education, including the offer of professional improvement of teachers. The current incentive system is, in practice, highly dependent on the policy and potential of individual communes (rates are determined by the leading authority) which decreases its efficiency;
- to examine the current level of knowledge and familiarity with provisions of the NSC among teachers of sciences within the scope of supplementing the school programme thanks to activities in centres of non-formal education (e.g. the group of teachers that is aware of such potential, whether they have an opportunity of using them and whether they are willing to do it, whether they look for offers that support the school curriculum among offers of centres);
- to promote, among teachers, the possibility of supplementing the programme implemented during classes thanks to the offer of centres (e.g. within the scope of conduct of experiments required in the NSC) – to encourage adoption of a more active stance in the use of offer of centres of non-formal education;
- to promote, among teachers, the value of prior preparation of pupils for participation in activities and the importance of continuing the subjects discussed during activities within the scope of teaching a given subject at school;
- to promote, among centres of non-formal education, the NSC (as an important and valuable document), to inform about convergence of objectives of the curriculum and objectives of operation of centres, to indicate mutual benefits related to adjustment of the centres' offer to the NSC requirements (e.g. a school receives support in the teaching of sciences and the

centres procure a partner and recipients), as well as social benefits of such cooperation in a longer time perspective (e.g. better educated graduates, more students and graduates of sciences);

- to support centres of non-formal education which conduct activities compliant with the general requirements of the NSC (e.g. system co-financing for centres or for schools for transport, cooperation with methodologists, transferring schools to such centres);
- to communicate, to centres, the needs of schools and teachers in curriculum implementation, e.g. during conferences regarding non-formal education;
- to enable, for the centres, to consult their offer with experts, methodological advisors, e.g. in the Ministry of National Education, to make the offered activities compliant with the general requirements of the NSC and constitute valuable support for teachers;
- to inform about possibilities of procuring additional funds – e.g. within the scope of cooperation with local government units, applying for EU funds;
- to stimulate cooperation among centres, to enable exchange of ideas, concepts, experiences, the pedagogical personnel, to encourage to creation of joint offers of several centres (cycles of activities, for example);
- to aim for establishing cooperation of schools and centres offering additional activities for pupils that encourage them to extend their skills in sciences (e.g. make laboratories available for performance of simple experiments, e.g. 723 Museum of Technology).

What is more, it is worth using – in line with the opinion of the Department of International Cooperation of the Ministry of National Education – information contained in this report regarding activities implemented for the benefit of children and young people in Poland in the sector of non-formal education as contribution to instructions for representatives of Poland participating in works of committees and working groups of the Council for Education, Youth, Culture and Sports of the European Commission. Exchange of best practices and exchange of information about activities in the area of non-formal education forms a part of the Open Method of Coordination applied on the level of the European Union in the areas of education and youth.

### **5.7.2. Recommendations for Centres of Non-Formal Education**

Even though centres of non-formal education do not create a system and there are no formal ways of central implementation of recommendations, it is worth indicating the activities that may be undertaken by such entities for better cooperation with schools and for support of teachers in the shaping and development of scientific reasoning skills.

Apart from obvious encouragement for individual adjustment to the conditions of a given facility of selected elements of best practice diagnosed in this study (cf. Chapter 4), it is also worth indicating the following activities:

- establishment of cooperation with the school environment – with principals, teachers, methodological advisors, for the purpose of better adjustment of the centre's offer to the needs of the school – both in the context of adjusting the centre's programme to the

recommendations of the NSC, to the needs of specific schools and groups of pupils, as well as in organizational issues (e.g. the needs related to provision of transport, accommodation, board, additional care, etc.);

- establishment of cooperation with other centres – for the purpose of exchanging experiences, materials, creation of a broader, mutually supplemented offer of activities, etc. It is worth using experiences of these centres which boast of good cooperation with schools;
- detailed acquaintance with the provisions of the NSC, going beyond the content of teaching – taking into account the purposes and skills of general teaching and general and detailed requirements of the NSC within the scope of individual subjects.

Moreover, taking care of the support for centres in diversification of financing of operation, it is worth remembering that there is a possibility of applying for funds for co-financing activities within the scope of science education addressed to young people and implemented with their participation within the scope of programmes Youth in Action (until the end of 2013) and Erasmus for All (after 2013).

There is also a possibility of implementing science activities in centres of non-formal education within the scope of lifelong teaching of adults. In line with the regulation of the Minister of National Education of January 11, 2012 on lifelong teaching in out-of-school forms (Journal of Laws item 186 as amended), such centres may conduct general competence courses according to the teaching programme, taking into account a selected part of the general teaching curriculum, including sciences. This may constitute extension of offer of activities proposed by centres and also be another manner of procuring funds for operation.