

The Use of Living and Non-living Things during School Practice in Primary Science Education

Abstract

The goal of this article is to publish the results of research on the level of use of (non-)living things in primary science education. The results of the survey carried out at 28 schools in the region of South Bohemia, the Czech Republic, are being discussed in this article. In total, 203 teachers have reported various ways of using objects in their teaching practice in terms of science education at primary level.

Keywords: *living and non-living objects, primary education, science education*

Introduction

Living and non-living things (also called “objects” = anything of plant and animal origin, fungi, minerals and rocks) are a way of acquainting pupils with the environment.

According to the Framework Educational Programme (FEP) the primary school pupil should understand the basic science terms and principles, be familiar with the methods of scientific research and be capable of using skills and knowledge in specific situations (Jeřábek et al., 2007). Therefore, the use of objects is important because they can: (i) demonstrate particular as well as general attributes of living organisms, (ii) are subjects of observation or school experiments, (iii) not only illustrate the curriculum but also enable to sort, specify and generalize scientific knowledge, (iv) have a very significant motivational, aesthetic and ethic function (cf. Petr, 2010b). In science education it is decisive whether instruction takes place predominantly at the verbal level, whether the familiarization with nature takes

place by means of various didactic media, whether pupils have the opportunity of direct contact and manipulation with objects, or if they use them as subjects of observation, demonstration and school experiments.

Conditions of using objects in education have changed during the development of the Czech (former Czechoslovak) schooling system from the so-called general studies, which until 1976 had been part of the mother tongue instruction, through introduction of individual subjects of elementary science and elementary social/geographic studies, to the realization of the FEP in 2005. While the general studies were characterised as “reading with explication” (Dostál, s. a.), introduction of individual subjects has opened a new space for deeper and more science-oriented teaching (Petr, 2010c). The role of the teacher is crucial in education. As teachers found space to work with tangible objects in terms of general science in the past, currently in terms of the FEP and implementation of the school educational programme, the emphasis is placed on teachers’ competencies and activity. Besides generally focused themes of the biology of organisms or ecology, the teaching of living environment combines the use of objects with indication of the scale of organisms, the scope of which may differ in various educational concepts. The organisms are used as model objects to demonstrate attributes of living systems (cf. e.g. Endreny, 2002, Leddon, Waxman, Medin, 2008) or are used for comparison with elements of non-living environment and products of human activity which require no taxonomical knowledge (cf. Topsakal, 2008). At the beginning of school attendance (alternatively at pre-elementary education), the issue of the attributes of living organisms or of comparison of living and non-living things with other objects is not quite trivial and misconceptions might occur (cf. e.g. Keeley, 2011, Legaspi, Straits, 2011, Opfer, Siegler, 2004). For instance, younger pupils may not always perceive plants as living organisms (Stavy, Wax, 1989.) In the Czech and Central European environment (e.g. Germany, Austria, Slovakia, etc.) the knowledge of organism diversity is required, though it is delimited mainly by textbook contents (cf. e.g. Petr 2010a; Petr, Budková, Kovářiková, 2010). However, both concepts logically offer space for the use of living and non-living objects as illustrative tools in teaching the curriculum content to pupils.

The use of objects in primary education has even some further contexts. For instance, it is necessary to consider the persistence of a negative relationship (aversion, phobia) towards some living things (spiders, reptiles, mice, etc. – cf. e.g. Lososová, Rychnovský, 2002). Conceivable is also the use of taxa which are not the main part of the curriculum, yet their use is for many reasons very illustrative and suitable for demonstrating organism attributes. These are in particular insects (Barrow, 2002) or some inferior taxa (e.g. dragonflies, cf. Strub – Siegenthaler, 1999).

The goal of the research was to describe the current state of the use of living and non-living objects especially in teaching about the living environment at primary schools and to discuss perspectives, opportunities and possible limits of their use.

Methods

Data were collected using questionnaires submitted to teachers mainly in the region of South Bohemia, so that city schools, town schools as well as fully organised rural schools were included. Of 28 schools in total, responses were returned by 203 teachers (194 women and 9 men) with teaching experience ranging between 1 and 45 years (average 18, median 19 years). The majority of the respondents were former graduates of pedagogical education at the Faculty of Education, the University of South Bohemia (152 teachers). 16 teachers were graduates of the Faculty of Education at the University of West Bohemia, 20 teachers were graduates of other pedagogical faculties, 13 respondents did not state any faculty and 2 had secondary education. 183 teachers graduated with specialization in teacher training for primary schools.

The questionnaire contained open and closed questions using polytomous and even rating scale items (cf. e.g. Chráska 2007).

Results and discussion

The tools which the teachers use during science lessons were being investigated using a scale characterising the extent of use in classes (cf. Table 1).

Table 1. Teaching styles of science curriculum and their use in class

	0	1	2	3	4	5	n
static images (printed pictures, posters, slides, etc.)	0	2	11	33	25	26	3
illustrations in textbooks or books (atlases, encyclopaedias, etc.)	0	0	1	13	32	52	1
internet, computer presentations, photos in a PC	16	20	23	28	10	1	2
interactive board	47	15	11	15	6	3	1
computer programmes or games	38	27	17	10	5	0	1
film and video	8	24	25	30	11	1	1

	0	1	2	3	4	5	n
collected items and preserved (non-)living objects	5	17	22	36	15	3	1
alive or freshly collected objects	1	3	14	37	31	12	1
work with an object during a walking tour and/or an excursion (school surroundings, ZOO, museum etc.)	1	2	13	44	30	9	1

Note: respondents were answering using a scale 0–5, corresponding to grading by 20% (0 – the mentioned way is not used ... 5 – is always used), n – no answer was given, the data are presented in %.

According to the data obtained, pupils get into contact with real (non-)living objects quite often. (Non-)living objects are used by 80% of the teachers in more than 60% of classes, material from school collections is then used by 54% of the respondents in more than 60% of classes. Compared to freshly collected objects, the material from school collections is less frequently used given the fact that, according to the respondents, its wider use is restrained by the lack of storage space, problems with preservation or acquisition costs (cf. Table 5). 15% (12% + 3%) of the teachers mentioned the use of objects (fresh or from collections) almost in all science classes.

Nonetheless, the tendency of the respondents to overestimate the part taken by the use of objects should not be ruled out. For instance, the extent of use hereby reported is higher in comparison with the analysis of the teaching experience of pre-service primary school teachers, where the use of objects was reported in 47% of science classes (Petr, 2011).

Recent introduction of interactive boards to schools enabled innovative use of electronic resources, internet, computer software and audiovisual records in mediating the curriculum. It is therefore possible to merge these items and to consider them related. Curriculum mediated by (multi)media is used by 80% of the teachers in 60% of classes and by 31% of the teachers in 80% of classes.

The teachers also evaluated the effect of particular presentation styles of the curriculum based on efficiency (cf. Table 4). The use of real (non-)living objects was designated by the teachers as being efficient for mastering the curriculum, well accepted by pupils (motivational) and effective similarly to a walking tour or an excursion.

10 % of the teachers stated that they use a combination of all the options for the sake of variety in teaching. In comments, the respondents expressed the importance of working with (non-)living objects as an opportunity allowing pupils to obtain direct experience and to imminently verify and/or gain knowledge at school or during walking tours outdoors.

Table 2. Evaluation of curriculum presentation styles (natural objects) from the point of view of teaching efficiency and effectiveness

	1	2	3	4
static images (printed pictures, posters, slides, etc.)	21	8	22	24
illustrations in textbooks or books (atlases, encyclopaedias, etc.)	43	21	35	33
internet, computer presentations, photos in a PC	14	20	18	21
interactive board	17	26	32	35
computer programmes or games	10	23	10	15
film and video	20	32	17	23
collected items and preserved (non-)living objects	23	18	24	26
alive or freshly collected objects	67	51	51	57
presentation during a walking tour and/or an excursion (school surroundings, ZOO, museum etc.)	54	52	44	59

1 – the most efficient from the point of view of mastering the curriculum by pupils

2 – best accepted or perceived by pupils

3 – the most effective from the point of view of the teacher's work

4 – the most convenient from the point of view of the teacher – complex evaluation

The teachers use objects in classes mostly as didactic models or as an instrument to motivate pupils (cf. Table 3). Half of the teachers also use objects as material for observation and simple experiments. From the point of view of current trends in science education based on the constructivist approach (e.g. inquiry based education – Stuchlíková, 2010), conducting experiments and demonstrations is the key element of teaching. Responses such as “art activities” or “use in interdisciplinary relations” were classified as “other use” of objects.

Table 3. List of contexts in which teachers use particular objects

	%
mostly not used	5
motivation (e.g. demonstration of specimen at the beginning of a class, a theme, etc.)	71
didactic model to demonstrate attributes and characteristics	76
material for controlled observation, experiments or simple laboratory tasks	51
knowledge review (e.g. cognition, description, etc.)	45
other use	3

Furthermore, the teachers expressed their attitude to the significance of primary school pupils' knowledge of selected objects, e.g. taxa at the level of species and genus respectively. The majority of the respondents consider this knowledge to

be important (Table 4). Nevertheless, 67% of the teachers consider the current scale of representative (non-)living things (delimited by school documents) as optimal (10% stated, that the scale is lower and 8% believe it to be higher than optimum). The extent of object knowledge is then often determined by the teachers' own choice, which is then reflected in the contents of the educational programme (70%). When setting the extent of knowledge, 35% of the teachers follow textbook contents. The majority of the respondents use the set of textbooks by the Nová Škola publishing company (58%). This set of textbooks contains about 290 taxa at the level of species or genus (in the text or in the illustrations). The second most used set of textbooks (Prodos) contains more than 400 representatives of organisms. Thus, textbooks introducing a lower number of species (genera) dominate in favour of certain generalisation and clarification of the curriculum. When choosing the curriculum (the scale of species) 43% of the respondents take into account the natural conditions of the school surroundings.

Table 4. The significance of object knowledge from the teachers' point of view

	%
essential	16
important	67
important to a limited extent	14
unimportant	0

While inquiring about limits to the use of objects in teaching, 63% of the teachers did not provide any response (Table 5). This could mean that some teachers do not see any limits to the use of objects at school or use them in such a way and to the extent which does not represent any major problems. More extensive use and acquisition of objects requires certain amount of effort and demands a lot of time and experience or knowledge of natural conditions of the school surroundings. That is probably manifested in the 12% share of the teachers' responses, who considered the availability of objects to be the main obstacle despite the fact that a relatively common material is used in the primary education. Only 1 % of the teachers mentioned legislative barriers to the use of actual (non-)living objects in school despite the existence of numerous standards that must be respected during manipulation with living things (Nature protection act, hygiene regulations and the like).

Table 5. Existing obstacles to the use of (non-)living objects in classes from the teachers' point of view

	%
legislation and standards	1
school equipment	2
hygiene	2
financial costs	4
space for storage	5
short lifetime	5
time available during lessons	8
pupils' allergic reactions	8
availability of (non-)living objects	12
no answer	63

Conclusion

One of the conditions for successful achievement of the FEP goals is an inter-connection of teaching with real life and practical experience of pupils (Jeřábek, Tupý, 2007). Therefore, the use of (non-)living objects in science education is indispensable. From this point of view, the research results are relatively positive.

The research into the use of (non-)living objects in science classes at primary level concludes that: (i) a large number of teachers declare the use of (non-)living objects in science classes – 80% of the teachers integrate work with objects at least in 60% of elementary science and elementary social/geographic classes. However, based on these findings it is not possible to assess the amount of the work done with objects and its time distribution in lessons. Following the authors' empirical experience, (non-)living objects can be used in class, even though in a completely insignificant amount (just a brief survey of specimen lasting a few seconds), (ii) the most widespread way of illustrating the curriculum about the environment is by using visual aids replacing actual objects – it is used in 97% of classes, (iii) multimedia teaching tools are also widespread – 80% of the teachers use them in more than 60% of classes and further growth is expected given the on-going increase in school interactive equipment. However, this may represent reduction in familiarising with nature through real objects and, in the case of excessive media use (albeit very illustrative and attractive), can signify insufficient direct contact with reality necessary for pupils' motivation and achievement of educative goals.

Given the lack of pupils' interest in science and the deteriorating tendency in the results of comparative studies (cf. e.g. White Wolf, 2009, Palečková, Tomášek, Bastl, 2010), it is essential to permanently implement direct cognition of nature including the inquiry-based approach to science education, and to support pupils' inherent interest in nature. With suitable didactic methods and the use of (non-) living objects it is possible to deepen the understanding of natural processes and to facilitate the development of a positive relationship with the environment and its cognition.

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