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The New Educational Review

The Living Things in the Science Education at Primary School – The Video Research on the Current State of Instruction

Abstract

Results of an analysis of 30 biology classes of integrated sciences taught at primary schools are presented in this article. The research investigated the current state of the use of living things or their substitutes in selected thematic units of the educational area Man and His World. Results were obtained by analysing video recordings via the software Videograph.

Keywords: *living things, primary education, science education, video research*

Introduction

It has been a long time since Commenius stated his fundamental didactic principles, which are currently mentioned in many didactic publications (e.g. Kalhous & Obst, 2009). Respecting relevant didactic principles is an inherent condition of school instruction. In particular, science instruction has to be supported by many illustrative examples of living and non-living things, by a material of natural origin or through expedient didactic means. The use of living things (note: in this article the term "living things" corresponds to living organisms and all material of plant and animal origin) in the instruction enables (1) to demonstrate specific and general characteristics of living organisms or taxa, (2) to undertake school observation and experiments, (3) to illustrate, classify, concretize and generalize

biology knowledge and (4) to create a motivational, aesthetic and ethic context. The issue of the use of living things, natural material and didactic means in biology education at primary school is a subject of research that studies this topic from several points of view. For instance, demonstration of the characteristics of living things within instruction was studied by Stavy & Wax (1989), Endreny (2002) or Leddon, Waxman & Medin (2008). Didactic comparison of living and non-living things was studied by Topsakal (2008), Keeley (2011), Legaspi & Straits (2011) and Opfer & Siegler (2004). It is necessary to take in account the negative attitude of pupils towards some living things in connection with their use in education.

The main aim of the research, the results of which are presented in this article, was to carry out an exploration clarifying the extent to which living things, didactic means (aids) or media are used by primary teachers in science education.

The main research questions were: (1) How are living organisms with their biology presented in selected thematic areas and to what extent do teachers use them? (2) In the case of the use of living things, how and to what extent is it implemented? (3) In what context from the point of view of class phases, forms of instruction and teaching methods are living things directly or indirectly used in class?

The analysis of class video recordings was used to answer the above-mentioned questions. In comparison with other research methods (questionnaire, interview, direct observation, etc.) this approach allows for recording and analysing individual educational events ex post with regard to various aspects and eliminating possible subjective views. This methodology of data collection and processing has been used in the Czech pedagogical research since the 1980s (Janík & Miková, 2006, Najvar, Najvarová, Janík & Šebestová, 2011). Video studies are used in large international comparative studies TIMSS 1995, 1999 etc. (cf., e.g., Anonymous, 2006) as well. Some video studies of the instruction of several science subjects were conducted at the lower secondary educational level in the Czech Republic (e.g., Janík & Janíková, 2007, Janík & Najvar, 2008, Hübelová, Janík & Najvar, 2008 etc.). Data from video research on science instruction at the primary level are available (Najvar, Najvarová, Janík & Šebestová, 2011), which focused on, apart from other aspects, the use of didactic means and media in instruction.

Methods

Video recordings of selected classes were made over the period 2010–2011 with the application of research methods developed by The Institute for Research

in School Education of the Faculty of Education at Masaryk University in Brno (formerly The Centre of Pedagogical Research) and published in Janík & Miková (2006) and Najvar, Najvarová, Janík & Šebestová (2011). Written inspectional record was taken concurrently. The video recordings were analysed using the software Videograph (Rimmele, 2002). Category systems (cf., Appendix no. 1) were defined with respect to the aims of this research. Simultaneously, some related conditions were studied during instruction, such as class phases, forms of instruction and techniques of work with living things or ways of their presentation with the use of didactic means during classes. The events were coded with one second intervals and the obtained data represent proportions of observed categories to the total recorded instruction time.

Selection of participating teachers was possible and was realised in several steps. About 35 schools in the South Bohemian and 1 school in the West Bohemian Regions were approached at the beginning. Schools' accessibility and time availability were taken into consideration. Schools participating in other projects with the Faculty of Education were left out for their workload (research, providing teaching practice, etc.). Based on negotiations with headmasters and primary school teachers who taught third and fourth graders, six teachers (marked t1...t6) were selected to participate in the research. The duration of the pedagogical experience of these collaborating teachers ranged from 11 to 30 years. Five teachers were fully qualified for the primary education level and 1 teacher was a biology teacher qualified for the lower secondary school level, but taught at the primary level as well. The research sample was composed of thirty recorded classes taught by 6 teachers (4 – 6 classes per teacher) in the 3rd (3 teachers) and 4th (3 teachers) grades. This made it possible to study the entire thematic area in a sequence of numbers of classes and enabled the pupils to get accustomed to the presence of a researcher and a camera in the classroom.

Because of the involvement of the 3rd and 4th grade teachers, convenient themes expedient for use were analysed. These included themes in which work with concrete taxa was expected, such as classification (e.g., Vertebrata, Fungi, sporogenous plants, plant or animal taxonomy, etc.), body structure and function of organisms (plant body structure, photosynthesis, etc.) and ecology of some ecosystems (forest animals, field animals, living conditions, etc.). All at the primary level of course.

Following the methodology published by Janík & Miková (2006), a questionnaire of class typicality was completed by the teachers at the end of every recorded class in order to establish the teachers' subjective feelings that could affect the class course.

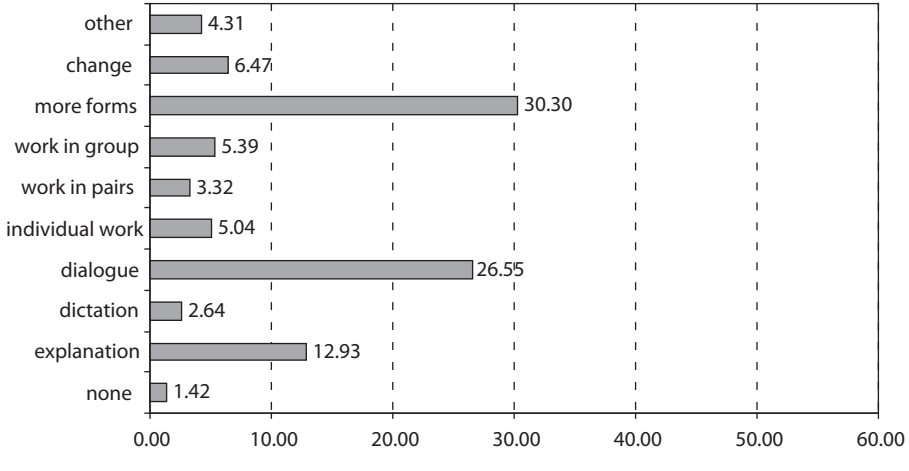
Results and discussion

Teaching forms

The incorporation of material aids or living things into instruction depends not only on the topic, but also on teaching forms or methods, on the organisation of class and its segmentation into individual phases. Teaching forms ratios were investigated with the use of category system published by Janík & Miková (2006). These authors call teachers' procedures in lectures "forms" although they are more likely to be considered as "didactic methods". This terminology was respected because it expresses a kind of "strategy" used by the teacher during instruction or an outward display of teaching methods and it is also useful for better comparison of obtained results with published data.

It was found out that dialogue was the dominant form of work with the curriculum. Dialogues were used in the initial phases of classes for their motivational role or as an instrument for revision and summarisation of the subject matter. New curriculum was deduced by dialogue as well. Dialogue proportion in the total time of instruction was 26.55%. This was comparable with the published data obtained by analysis of science subjects at the primary and lower secondary levels. For instance, Najvar, Najvarová & Janík (2009) state a 23% ratio in geography and 34% ratio in physics classes. Also, more than a third of science instruction at the primary level consists of dialogue (Najvar, Najvarová, Janík & Šebestová, 2011).

Figure 1. Teaching forms proportions in observed classes (%)



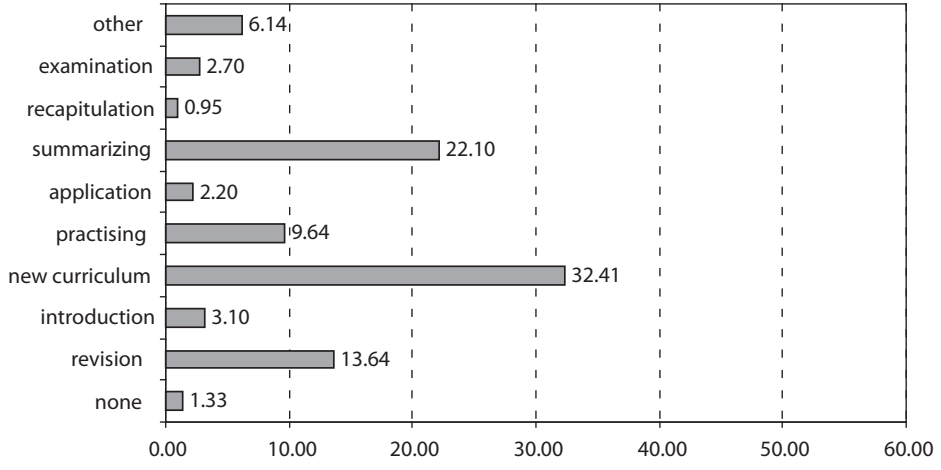
A combination of parallel occurrence of several teaching forms was slightly higher (30.30%). Also in this case dialogue was generally combined with other forms. For instance, dialogue accompanied by presentation or description of a picture, dialogue during individual or group work, dialogue during performing an experiment, etc. It represents natural communication between the teacher and pupils. Individual tasks included work with worksheets and practice books or note-taking. The observed proportion of group work (5.39%) resulted primarily from two successive classes entirely organised as group work under the teacher's (t6) supervision. Proportions of the remaining forms (methods) are displayed in Figure 1. The obtained data show that most of the observed instruction was pupil-centred or oriented to communication between the teacher and pupils. Only about 15% of the instruction was teacher-centred. It means that pupils were active during the instruction or they were led to activity by their teacher for most of the time. Situations related to preparation of aids, changes in the organisation of instruction (formation of groups, rearranging of pupils in the classroom, etc.) were coded as the "change" category. The category "other" (4.31%) included forms difficult to classify, such as didactic games. Small representation of dictation corresponds to the character of the studied classes and includes, e.g., note-taking (in notebooks and worksheets) according to the teacher's instruction.

Class phases

Formation of new knowledge was the most frequent phase of the observed classes (in total, 32.41%). This was followed by revision (13.64%) and summarising (22.10%). These results are slightly different from the data published by Najvar et al. (2011), which showed that practising and consolidation of the curriculum were the most frequent. Pupils have an opportunity to familiarize with living things, manipulate or work with them in a different way in all phases of the class. In our case, the curriculum was accompanied by a living thing and other material aids mostly during building new knowledge (demonstration of taxa, illustration of subject matter during presentation) and during summarising and recapitulating (work with pictures in worksheets or schoolbooks, work during didactics games, work on individual tasks). Because most of the analysed classes had explanatory character, examination took up only a small part of the total time. Less than 3% of this category is related to three written tests. About 10% of the time was devoted to practising.

Didactic games, competitions, work with tasks from workbooks or schoolbooks were common forms of practice. The application of knowledge by solving problem tasks was observed only in the case of two teachers (t2 and t3) and it amounted to only 2.20% of the total instruction time.

Figure 2. Class phase proportions (in%)



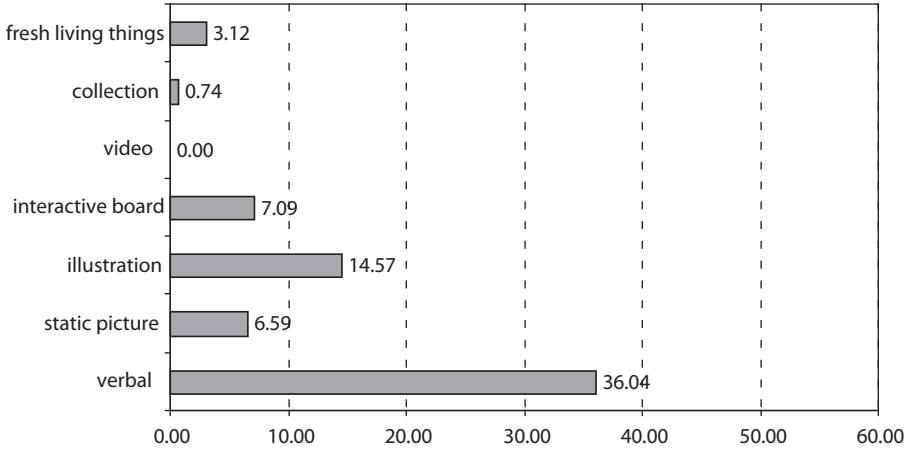
Therefore, the knowledge acquired is recapitulated, summarised and examined, but the pupils use it minimally during solving problem tasks.

Forms of subject matter mediation

The above-mentioned research outcomes illustrate some conditions and situations which determine the use of didactic aids. A category system was created in order to analyse the use of living things, material from the school collection and other static or dynamic didactic aids in the instruction. This category system also included situations with verbal presentation of the subject matter. All forms of instruction dealing with naming, sorting and describing of organisms (with their biology) without the use of illustrations of concrete material, pictures or other visual aids were placed into the "verbal" category. Verbal presentation of the subject matter was represented by several forms of instruction, such as discussion, individual work oriented to classification of organisms (cards with some text) and didactic games (guessing names on the basis a verbal description of plant or animal, a puzzle – with the solution of the name of a taxa, matching of genus names and species names, text reading about organisms, etc.).

The obtained data show verbal work with the subject matter as the prevailing method (36.04%). In comparison with Najvar, Najvarová, Janík & Šebestová (2011), this proportion of verbal instruction is about 14% lower in favour of instruction with the use of didactic aids.

Figure 3. The use of living things with respect to other ways of subject matter presentation (%)



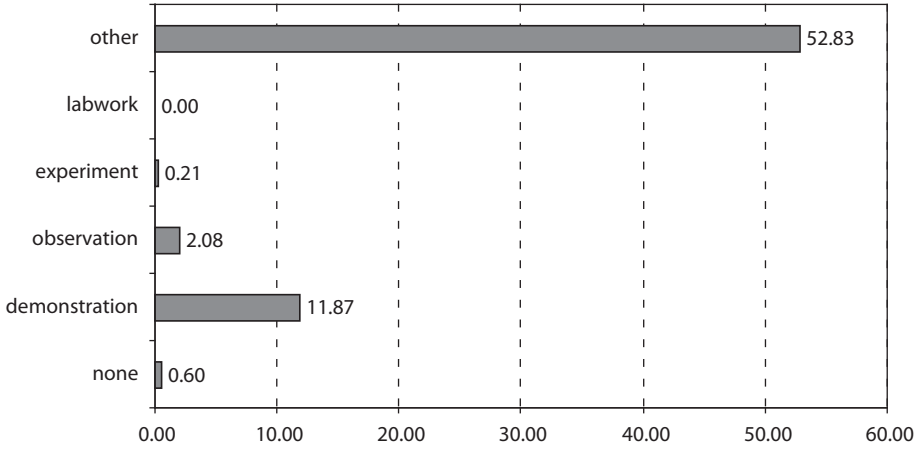
The dynamic presentation of living things (category "video") was not used during the observed classes. Not even in the cases where an interactive board and PC projection were available in the classrooms, thus enabling its trouble-free implementation.

A static picture was often used in addition to verbal methods. The category "static picture" includes a presentation of visual information via an interactive board, an illustration (schoolbooks, encyclopaedias, guides, etc.) and frontal presentation of pictures (sketch on black/whiteboard, books, displayed wall picture, poster, etc.). The pupils had the possibility to look at a static picture in 28.25% of the total instruction time. Some forms of presentation of pictures were difficult to code because they were often overlapped with other activities in the classroom. For instance, during individual work with worksheets it was hard to distinguish the pupils dealing with picture-based tasks from those that already progressed to text-based tasks. Situations when pictures stayed in a visible place (interactive board, flipchart, etc.), but the pupils' attention was focused on other activities or objects were not coded, although it is clear that the pupils could observe those pictures incidentally.

Demonstration of collected material, e.g., seeds and fruit of some farm plants, herbarium sheets (e.g., plant leaves) or fruiting body of fungi, were categorised as "collection".

Freshly obtained living things or items coming from the school collection were used only minimally (3.86%). For primary teachers it is difficult to obtain or use some living things during instruction. On the one hand, some situations were noticed when living things were used in an unconventional context, such as themes oriented to natural conditions of ecosystems and life conditions, e.g., an experiment demonstrating the role of vegetation cover against erosion. On the other hand, living things were not used in situations where their use could be absolutely common and easy (e.g., broad-leaved trees or coniferous trees).

Figure 4. Forms of work with living things or substitute didactic aids (%)



Forms of use of living things and other aids

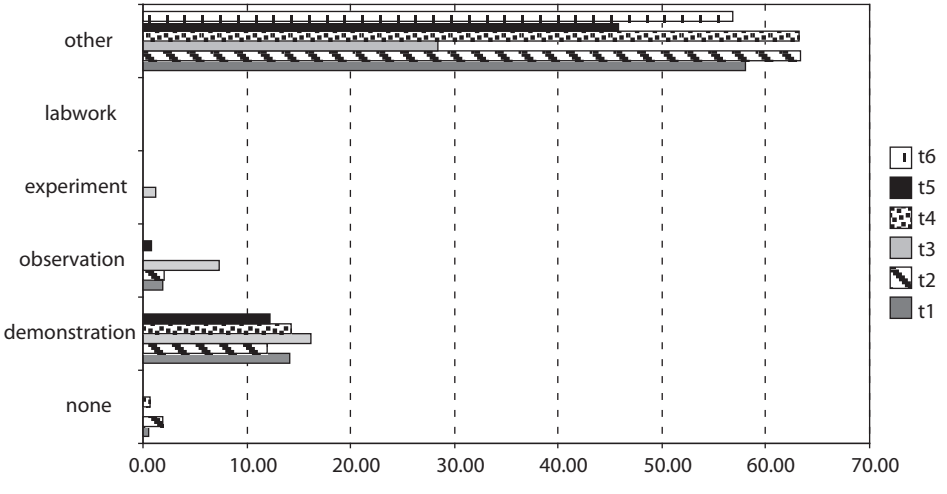
The fourth category system is related to the previous one and deals only with the use of living things in comparison with their mediated presentation (e.g., by pictorial display). In this case, the category "other" represents all forms of presentation of pictorial material in a frontal, group or individual way. Typical use of living things by their frontal presentation accompanied by observation, lab work or experiments was observed only in a limited number of cases. It is expressed by a low percentage value representing the proportion of these activities with respect to the entire time of instruction (2.29%). The following cases were recorded: demonstration of oyster mushroom (*Pleurotus ostreatus*), a frontal experiment demonstrating soil erosion, presentation of leaves and observation of *Pelargonium* leaves during learning about plant anatomy.

The category "demonstration" is related to demonstration of organisms (species resp.) characteristics by using pictures. It generally included demonstration of the body structure of animals, of which direct demonstration or demonstration of prepared material was not possible in conditions of primary school (protected animals, availability, size, health protection, etc.).

The class research sample represents only a specific sector of reality and it does not capture the whole range of teaching methods and forms used by the participating teachers. The teachers mentioned the use of short and longer excursions depending on current conditions of respective schools. The mentioned excursions were usually oriented to observation of organisms in their habitats and they took place, e.g., in the school garden and localities in the immediate vicinity of the school.

Figure 5 compares the above-mentioned data in relation to individual participating teachers. It is evident that they used comparable forms of mediating the subject matter. Instruction of teacher t3 showed higher representation of observation. This teacher had teaching qualifications for the lower secondary level in biology.

Figure 5. Comparison of forms of use of living things and teaching aids among individual teachers (t1 – t6)



Typicality of classes

Presence of a camera in the classroom is a non-standard event. Therefore, it is necessary to determine if the videotaped classes are adequately typical or show

some anomalies. Signs of nervousness and uneasiness were exhibited by the teachers at the beginning of the research, but they gradually disappeared. Most of the classes were considered by the teachers as typical or almost typical (96% in total) (Table 1). The pupils' behaviour was described as similar or nearly similar to that in other classes (93% in total). The teachers' nervousness was demonstrated during the first or second class and fell afterwards into the categories "practically not nervous" or "not nervous". The overall impression was stated by the teachers in the last question. In total, 89% of the classes were positively assessed. The above-mentioned findings indicate that video recordings were originating under relatively standard conditions that were comparable with other research.

Table 1. Teachers' statements about the typical character of classes

Was the recorded class typical in comparison with your other classes?	
Absolutely typical	59%
Almost typical	37%
Non-typical	4%
Absolutely non-typical	0%
How would you characterize the pupils' behaviour during the recorded classes? In comparison with the common situation their behaviour was:	
Very similar	63%
Similar	30%
Slightly different	7%
Very different	0%
How did you feel during the recorded class?	
I was very nervous	0%
I was slightly nervous	30%
I was practically not nervous	26%
I was not nervous	44%
The recorded class went well.	
I disagree completely	0%
I disagree partially	11%
I agree partially	67
I agree completely	22%

Conclusion

The following facts were found based on the video analysis of 30 classes of integrated sciences oriented to learning about the animated nature:

1. The proportion of the use of real living things or natural objects was lower in comparison with the mediated presentation of organisms. Only less than 4% of the observed classes contained work with living things. It was usually represented by frontal demonstration accompanied by observation.
2. If other didactic means were used it was mainly via static pictures in schoolbooks and encyclopaedias, frontally situated pictures or projections on interactive boards (28% of the total time)
3. The dialogue between the teacher and pupils or a simultaneous combination of several forms was the most often used instructional form. The discovered proportion, of about 26% of these events, corresponds to the published results of other video studies.

Acknowledgement: This article was published with the financial support of the project GAČR 406/09/1039. The author gives thanks to all the participating schools and teachers for their collaboration.

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Appendix 1:

Definition of categorial systems for coding of records

Categories used for coding teaching forms (modified according to Janík & Miková, 2006)

other	sequence not classifiable elsewhere
change	distinctive landmark in instruction, due to, for example preparation of aids or workbooks, shifting of pupils, etc.
more forms	simultaneous application of more forms, e.g. explanation parallel with group work etc.
work in group	pupils autonomously work in groups composed of 3 and more pupils
work in pairs	pupils autonomously work in pairs
individual work	pupils work autonomously
dialogue	teacher-pupil interaction of type "question-answer"
dictation	The teacher presents text, pupils write (oral communication and/or written text, etc.)

explanation	explanation or monoloug of the teacher
none	interruption of the instruction such as school announcement, discipline problems, etc.

Categories used for coding lesson phases (modified according to Janík & Miková, 2006)

other	sequences not classifiable elsewhere
examination	written or oral examination
recapitulation	feedback oriented on learning process, not summarization of curriculum
summarizing	summarizing of content by dialogue, presentation etc.
application	curriculum used in new situations, solving problem-oriented tasks
practising	fixation of new curriculum, solving routine tasks (e.g. in workbooks)
new curriculum	presentation of new curriculum by presentation, dialogue, individual work etc.
introduction	communication of a theme or aim, introduction to new thematic area
revision	revision of previous curriculum
none	phases are not recognizable – situations before the start and after the ending of the instruction

Categories used for coding the use of didactic means

fresh living things	work with real and freshly gathered material
collection	work with material from the school collection
video	presentation of a video
interactive board	work with interactive board (presentations, presenting of illustration, etc.)
illustration	work with printed illustrations in textbooks, encyclopaediae etc.
static picture	frontal demonstration of a static picture – poster
verbal	instruction without visual aids (verbal description, dialogue, reading, cross-word, some competition, etc.)

Categories used for coding methods of work with aids and living things

other	curriculum demonstration by didactic aids, chiefly by pictures – all other forms except direct work with living things
labwork	laboratory work
experiment	frontal or pupils' experiment
observation	observation under teacher's supervision
demonstration	demonstration of characteristics of organisms through static image
none	short-term interruption of work with living things or aids caused by external reasons