LEARNING TASKS IN NATURAL SCIENCE TEXTBOOKS AS A TOOL FOR PUPIL'S DEVELOPMENT OF SCIENTIFIC LITERACY

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Abstract: Development of pupils' scientific literacy is considered to be a general goal of education in natural science as early as in elementary school. A learning task is one of the elementary tools that teachers employ to reach the goals in science education. This article deals with the analysis of learning tasks in selected natural science textbooks for the 5th grade, in particular the topic of water, and their potential to develop scientific literacy. The results show that the learning tasks, that would require more complex thinking skills, can be found in a limited number. Nonetheless, it is just the more complex learning tasks that stimulate, motivate and make more sense to pupils. The content of these tasks has inherently more potential to fully develop scientific literacy. In the article, we point out that there is a disproportion between these complex tasks and those which require only memorising of facts. The above mentioned fact is increasingly important taking into account that the textbooks are still considered one of the dominant material-didactic resources in natural science education even in the era of information and communication technologies.

Key words: scientific literacy, natural science education, learning tasks, natural science textbooks

Introduction

We live in the 21st century, characterised as dynamic with relatively rapid changes. One must learn throughout life, must be able to respond flexibly to life circumstances and situations (compare e.g. Oelszlaeger, B. 2007 and 2011). School education has been trying to respond this fact as well. In the field of natural science, which we want pay attention to in the article, one of the leading concepts is that of scientific literacy. The term scientific literacy has a relatively rich history and as shown for example in Laugksch (Laugksch, R. C., 2000) the concept of this term is considerably problematic because there are many interpretations, conceptions and perspectives behind this comparatively a simple term. That is why the concept of scientific literacy is often considered to be difficult to grasp and measure. Nevertheless, it is possible to observe a certain level of consensus in that a scientific literate person should be able to understand the position of science (natural science) in society and its impact in everyday human life.

As Hrubišková and Veselský state the importance of functional science education of an individual has been increasing constantly to be able to live and work in modern society that is cognition oriented . (Hrubišková, M. and Veselský, H., 2009). On one hand, it is given by the acceleration of new scientific findings that result from the intersection of technology and more sophisticated methods into natural scientific research and on the other hand, it is also by a dynamic use of new findings in practice of individuals and society.

Scientific literacy and Framework Educational Programme

The PISA research was carried out to assess the state of science education of pupils, including the relevant competencies and skills, ending elementary school in OECD countries. In the research, in which pupils were tested, the term scientific literacy was defined as *"the ability to use scientific knowledge, identify questions and to draw evidence-based conclusions for understanding and making decisions about the natural world and the changes that have been made to it as a result of human activity"* (PISA 2006, 2007, p 29). This definition has been criticised as well (e.g. Štech, S., 2011; Kaščák, O. and Pupala, B., 2011) for the lack of consideration of cultural particularities. The concept of scientific literacy was elaborated in detail for example by Bybee (Bybee, R. W., 1997). It was just his concept of scientific literacy that was used for the needs of the above mentioned international PISA research (Straková, J. et al., 2002; Palečková, J. and Tomášek, V., 2005).

The National Institute for Education developed a concept of scientific literacy divided into four basic aspects (Černocký, B. et al., 2011). To some extent, the concept of scientific literacy overlaps with the concept of competencies, in particular the problem-solving competencies (RVP ZV, 2007).

The concept of scientific literacy	**The key competencies of RVP ZP (Framework Education programme)**
Active **learning and use of (basic elements) the conceptional system of natural sciences** (basic concepts, fundamental laws, hypotheses, theories and models)	information searching and sorting are based on its understanding, they make use of combination and systemisation in the learning process, creative activities and practical life
learning and usage of methods and procedures of natural sciences - **empirical methods and procedures** (systematic and objective **observation, measurement, experimentation**), rational methods and procedures	independently observe and carry out experiments, obtained data are critically compared, obtained results are assessed and conclusions are drawn to be used in the future

(**conclusion formulation** based on analysis, data processing or evaluation (induction), **conclusion drawing** from scientific hypotheses, theories or models (deduction), **problem or problematic situations identification strategies** and problem-solving possibilities in natural sciences research)	perceive various problematic situations inside and outside the school, recognise and understand the problem, think about inconsistencies and their cause, think over and plan the way of solving problems for which they use their own judgement and experience solve problems independently, select appropriate solutions, use logical, mathematical and empirical procedures to solve the problem
Active **learning and use of principles for evaluation of natural science knowledge** - testing methods of objectivity (confirmation or refutation), reliability and truthfulness of scientific assertions (data, hypotheses, etc.), methods of detecting errors or data distortion in scientific research, methods of critical evaluation of pseudo-scientific information	critically assess obtained results and draw conclusions that are to be used in the future
Active learning and use of ways how the scientific knowledge interacts with other segments of human knowledge or society - systematic use of mathematical tools and modern technologies in science learning, use of obtained scientific knowledge and skills for personal decision-making when solving or evaluating various practical everyday problems or deciding on a career orientation, use of obtained scientific knowledge and skills to evaluate objectivity and truthfulness of various information in media, taking stand on various use of scientific knowledge in practice and its consequences	use of information and communication technologies to communicate in an effective and quality way with the outside world use obtained communication skills to build relationships needed to adequately coexist and cooperate with other people effectively use information in the learning process, creative activities and practical life

Table 1: Aspects of the scientific literacy and key competencies in FEP - comparision

Competencies are the target category and they are developed into expected outcomes and further specific goals of individual thematic groups and teaching units. In truth it is (not only) the learning process as such that shapes pupils' literacy. The **goals** determine the direction of education. If teachers are to systematically manage learning activities of pupils, if they want pupils to reproduce, compare, deduce, etc., they need to create such conditions that would lead to these activities really appear in the class. What induces the learning activities are **learning tasks**. (Tollingerová, D., 1986)

Learning tasks and questions induce learning activities of pupils that head towards established teaching goals. Learning tasks and questions are bearers of curriculum and their purpose is to help pupils to explore and test the level of acquirement by individual pupils. At the same time, learning tasks should **support interests and needs as well as abilities and learning possibilities** of pupils. (Švec, V; Filová, H. and Šimoník, O. 2003, p 53-54).

It is then possible to consider learning tasks as one of the tools to achieve goals of scientific education and thus scientific literacy.

The potential of learning tasks also lies in activation of pupils and the task should be formulated so that it is **a challenge to solve it**. It is not something that pupils should passively listen to, it should be a stimulus for them to participate actively. Opportunities to learn are considered as a challenge stimulating pupils to be engaged with curriculum, or more precisely with learning tasks. In education learning tasks act as a **specific set of demands placed on pupils' learning** (Vaculová, I; Trna, J. and Janík, T., 2008).

It is a part of **transformation** (conversion) **of educational content into a form that is accessible** to pupils and with which they can work. Usually, it is a conversion of educational content from the form that is unavailable to pupils into the form that pupils can learn. (Knecht, P. and Janík, T., 2008).

As a rule, it is up to teachers to prepare, gather, differentiate and select learning tasks for pupils. There are plenty of sources from which they can draw from (the Internet, worksheets, workbooks, textbooks).

The learning tasks

In the article, the attention is paid to textbooks and learning tasks incorporated in them. Even though there is an increasing number of electronic educational materials on the market, a printed paper **textbook still retains its prominent place among didactic materials** that teachers and pupils use during lessons. This is given by their affordability (unlike higher-priced IT technologies), concerns that a number of teachers (mainly the older ones) have about their use as they do not have enough experience using these technologies and last but not least, there is also a certain influence of tradition.

As it was found by Sikorová, textbooks quite strongly influence curriculum (Sikorová, Z., 2010). That is why we have compared the topic of water (especially the conceptual analysis) in selected natural science textbooks (available to us). Maňák states that *"a textbook is an epitome of educational programme (curriculum) and teachers are not obliged to use it in respect of content or methodology. Yet the current textbooks respect the traditional content, there are differences mainly in extent of curriculum and its methodological interpretation."* (Maňák, J., 2007, p 25) Learning tasks belong, by their characteristics, to the control system of learning in the theory of textbooks (in terms of textbook components). Jůvová found out that the coefficient of the control system, in which learning tasks are included, is very low (Jůvová, A., 2006). This means that text presenting curriculum prevails. Yet learning tasks do appear in textbooks. A question may be also considered as a specific type of a learning task. The Learning task is formulated in an interrogative manner or it may be a part of a more complex learning task. (Švec, V.; Filová, H. and Šimoník, O., 2003, p 54).

Research design

We carried out a research on learning tasks in selected textbooks of natural science. Researches on textbooks for lower primary school are rare (e.g. Podroužek, L., 1999), they focus on particular topics, e.g. Panáková carried out a conceptual analysis of healthy nutrition (Panáková, G., 2010).

We selected available textbooks to be analysed. These textbooks were compiled by the rules of Framework Education Programme for Elementary Education, i.e. natural science textbooks by Didaktis publishing - The Humankind and its World for the 4th grade, The Humankind and its World for the 5th grade; Fraus publishing - Nature: The Humankind and its World for the 4th grade, Nature: The Humankind and its World for the 5th grade; Státní pedagogické nakladatelství (SPN) publishing - Natural Science 4 and Natural Science 5; Alter publishing - The Humankind and its World - Diversity of Nature.

We used the method of text descriptive analysis and chose the **psycho-didactic approach** (see Knecht, P. and Janík, T. 2008, p 91) in which we focused on **types and quantity of learning tasks**, or more precisely on what the potential of selected books is to engage pupils, stimulate them and their own thinking on a certain topic of natural science.

As a criterion, we determined the classification of learning tasks by Tollingerová (Tollingerová, D., 1986) in which learning tasks are divided into five categories according to the cognitive demands (from the simplest): 1. Learning tasks requiring commemorative reproduction of knowledge; 2. Learning tasks requiring simple mental operations with knowledge; 3.

Learning tasks requiring complex mental operations with knowledge; 4. Learning tasks requiring communication of knowledge; 5. Learning tasks requiring creative thinking.

Research results

Simply we can say that to be able to solve more complex learning tasks, it is necessary to have competencies to solve learning tasks from a lower category.

In total, we detected **120 different learning tasks** for the topic of water in researched textbooks, most of them had a format of a **question**. In one textbook there was no learning task at all (SPN publishing for 5th grade) that would be connected to the topic of water. This is probably caused by the fact that the topic of water was not explicitly stated in this textbook. On the contrary, the highest number of learning tasks was in the textbook for the 4th grade (41 learning tasks) by Fraus publishing. **The average number of learning tasks per a textbook is 15**. If we counted the textbooks with the topic of water only (5 textbooks), **it would be 21,6 learning tasks per a textbook**. From this point of view, the number of learning tasks seems relatively sufficient. The tables below show the qualitative aspect of the learning tasks and the quantitative comparison will be performed.

The type of a learning task	Absolute frequency	Relative frequency (with respect to **all** learning tasks)	Relative frequency (with respect to **category**)
1. memory-based reproduction of knowledge	**51**	**42,50%**	
1.1 re-learning	1	0,83%	1,96%
1.2 reproduction of facts, terms	44	36,67%	86,27%
1.3 reproduction of definitions	6	5,00%	11,76%
2 simple mental operations with knowledge	**29**	**24,17%**	
2.1 identification of facts	11	9,17%	37,93%
2.2 enumeration and description of facts	5	4,17%	17,24%
2.3 enumeration and description of processes	5	4,17%	17,24%
2.4 analysis and synthesis	3	2,50%	10,34%
2.5 comparison, differentiation	2	1,67%	6,90%
2.6 classification	1	0,83%	3,45%
2.7 identification	2	1,67%	6,90%
3 complex mental operations	**28**	**23,33%**	

with knowledge			
3.2 explanation, explication	14	11,67%	50,00%
3.3 deduction	4	3,33%	14,29%
3.4 derivation	9	7,50%	32,14%
3.5 proving, verification	1	0,83%	3,57%
4 learning tasks focused on knowledge conveyance	**2**	**1,67%**	
4.1 creation of overviews, abstracts, contents, etc.	2		100%
5 creative thinking	**10**	**9,17%**	
5.1 practical use	4	4,17%	50,00%
5.4 exploration based on own observation	5	4,17%	41,67%
5.5 exploration based on own reflections	1	0,83%	8,33%

Table 2: Types of the learning tasks in natural science textbooks (topic: water)

Facts memorising and simple mental operations occupy almost 70% of all the learning tasks - in the given thematic group. They differ in concept of individual textbooks (more in Šimik, O., 2012).

The analysis then proves that the aim of most of the textbooks is to **make pupils learn facts** that are presented **in the textbook. Pupils work out most of the learning tasks with the help of the textbook** and there is no need to work with other sources. There may be certain advantages (mainly material ones) but on the other hand, the curriculum and its presentation is limited to one source to some extent. There are 2x less of learning tasks thanks to which pupils would do fact findings on their own. The textbooks do not encourage to make use of knowledge in practical life, even though there certainly are exceptions.

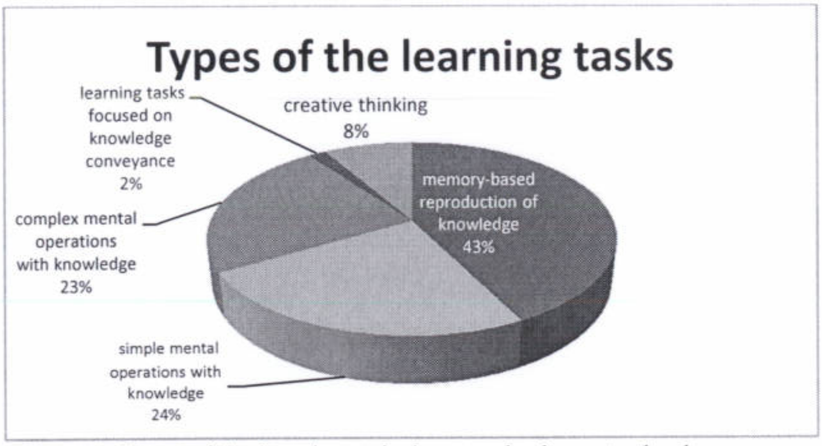

Figure 1: Types of the learning tasks in natural science textbooks

We are going to focus on the learning tasks with complex mental operations, creative learning tasks and learning tasks that require conveyance of knowledge.

There were only 2 learning tasks in the 4th category (learning tasks focused on knowledge conveyance): *Make a record keeping card for this experiment and write down your observations during the period of several days until all water evaporates from the dish. What have you found out?*

Make a record keeping card for this experiment and write down your findings. (the experiment with water lines in a plant)

The highest number of learning tasks was focused on explanation and less on derivation and deduction in the third category.

Learning tasks focused on explanation:
Why is the Earth called a blue planet? Look at the scheme and explain how water circulates on the Earth. Would you be able to explain how the lake was formed when looking at the picture? (learning task 2.5 if with a picture) Why do we have to increase the intake of water during hot days or when having a fever? Why do we have to water plants more during hot days than during cold days? Why should not we be pouring detergent out into water in wild nature? Why is it not a good idea to build houses right next to brooks and rivers? Why do we not touch power points with wet hands? Explain in what way polluted water can harm a man. Explain in what way water can make our lives unpleasant. Explain why people who have wrecked on the sea suffer (die) of thirst without supply of drinking water Poodles dry quicker than in (summer - autumn). Explain why. Explain why people must not let out used oil into the soil even on their own backyard or garden. If

there is underground water contamination, will the water be contaminated just under the land of the culprit? (There is an answer to one question at the beginning of the following question, which brings down the learning task no 3 to category 1.1 - re-learning). Try to explain why and how water pollution in one part of the world can influence unpolluted water in totally different and remote parts of the world.

Learning tasks focused on deduction/derivation

What would happen if we did not protect oceans but pollute them?

What is the link between the Sun and air/water flow on the Earth? natural phenomenon important for life

1. What would you point out to people that were about to wash their car at a river or a water reservoir? water protection

2. Tell us how people should behave in areas with the following signing: Attention, water protected area.

What happens to water that is absorbed into the soil?

Think about the cause of spring floods (learning task 1.2 if with a picture)

Is underground water always suitable for drinking?

Could there be life as we know it from the Earth?

What water can castaways drink on sea? (all three questions only with an attached explanation, otherwise 1.2)

What would happen to life on the Earth if the water cycle stopped?

What could be the cause of water cycle cessation on the Earth?

What may happen if there has been heavy downpour and lot of water rained just within a few hours?

What may cause heavy or long-lasting snowfall during winter?

What is the influence of water to life of plants and animals?

Learning tasks focused on proving/verification

By a simple experiment try to find out how quickly water is distributed within the body of a plant. Observe how long it takes for white petals of individual carnations to get coloured by ink.

Figure 2: Learning tasks „Complex mental operations with knowledge“

Within the highest category of learning tasks (those focused on creative thinking), we found only **ten tasks**, which is less than 10% of all the tasks that were examined for the topic of water.

Learning tasks focused on practical use

Try to calculate how much water you use every day.

1. Suggest a way how to stop water pollution in rivers and ponds.
2. Suggest a way how to water plants in case of draught.

Discuss the ways every person, that includes you as well, can contribute to the state that there is enough unpolluted water for everybody.

exploration based on own observation Find out why salt cannot get away from seawater. (experiment) "scientific work" 1. Experiment: Examination of saltiness of water. Try a drop of the solution and tell what it tastes like Try tapped water. Is it really fresh (yes - no)? What is the colour and taste? Try to find out three different states of water in your surroundings. Write down where you can encounter water in a liquid, gaseous and solid state? 2. Experiment: Change of state of water (vaporisation of water in a warm and cold place). Observe and write down why it is like that and where the water "disappears". 3. Experiment: Water condensation from air. Write down outcomes of your observation. 4. Make an experiment about surface tension. Write down what have you observed in your own words. **exploration based on own thinking** Suggest how it is possible to save water (use in life, creativity)

Figure 3: Learning tasks for develop creative thinking

If we pay attention to characteristics of learning tasks focused on explanation, then we can find these elements:

a) explanation of an interesting natural phenomenon that pupils may encounter (e.g. Why is the Earth called a blue planet?) Poodles dry quicker than in (summer - autumn). Explain why. - in these learning tasks there is an opportunity for pupils to use their own experience, the source may be pupils' questions related to a certain phenomenon or term.

b) working with schemes, pictures, graphs (transliteration) – e.g. explain how water circulates the Earth according to the scheme. This type of learning tasks leads pupils from iconic thinking to symbolic thinking, it develops their ability to work with verbal sources and there are possibilities how to verify if and how pupils understand a given topic.

c) explanation of phenomena and activities related to practical life of people – e.g. why do we have to increase the intake of water during hot days or when having a fever? Why do we have water plants more during hot days than during cold days? Why do we not touch power points with wet hands?, etc. - learning tasks formulated this way are in fact connected to the practical life of pupils and enable them to think knowingly about situations and phenomena they usually encounter.

Conclusion

We have traced certain common elements that are incorporated in more complex learning tasks, i.e. more complex mental operations, creative thinking or conveyance of knowledge. To some extent these elements agree with (resemble) individual fields of scientific literacy.

1) more complex learning tasks lead to identification of life situations in pupils' lives that include elements of natural science and technology (psychomotor/social dimension) – these learning tasks are close to pupils' life context, they support or confront their life experience. In order the teachers could make such learning tasks, they ask questions like: In what situation can pupils encounter this phenomena, concept? How is it related to pupils' life? In terms of scientific literacy, these learning tasks relate to the context category, i.e. in what ways natural science and technology influence people's lives. Natural science is not beyond practical life, but it influences it. By these learning tasks, pupils learn to find connections between curriculum and everyday life.

2) more complex learning tasks lead to understanding of natural phenomena and develop scientific thinking (cognitive dimension) – mainly creative learning tasks and learning tasks focused on explanation of knowledge by pupils. There is a great emphasis on learning with comprehension in modern didactic. Pupils seek the meaning of learning (why should we learn this?) and it is difficult to achieve meaningfulness without understanding. In this context, teachers must ask questions related to curriculum selection as scientific disciplines, that create a source of knowledge in an integrated subject Humankind and its world, are very extensive. Which terms and phenomena should pupils understand and they are "worth" to be selected? What do pupils have to do to understand it? Understanding of younger pupils is connected to factual thinking and thus it is important for pupils to have opportunities to meet the selected phenomena through as many senses as possible. At the same time, there are learning tasks that are similar to the job of scientists (asking questions - hypotheses, measurements, problem determination, problem solutions, observation, simple experiments, etc.). Then pupils can study the phenomenon practically and explore connections which brings about a better understanding.

3) more complex learning tasks include a motivational drive and develop the relationship to natural science (affective dimension) – these learning tasks do not require mere repetition, memorisation. Usually, they are more interesting for pupils as they carry a potential cognitive conflict within them (I do not know - I want to know) and support inner motivation of pupils. As an example we can use a science experiment that on one hand motivates pupils and on the other, it presents a problem that needs to be solved.

Let us finish with a quote (Svobodová and Sládek, 2008, p 43): "*If we did not feed students* (pupils) *with terms and relationships* (learning tasks focused on knowledge reproduction) *for which they do not have enough intellectual capacity yet, if we let them to have a look at the nature through* ***specific****, but less noble, problems and to let it* ***confront*** *with their own* ***experience****, pupils would get skills and insight that are more in cope with so often declared aims of education in natural science.*"

References:

BYBEE, R. W. 1997. *Achieving scientific literacy: From purposes to practices.* Heinemann, 88 Post Road West, PO Box 5007, Westport, CT 06881.

ČERNOCKÝ, B. et al. 2011. *Přírodovědná gramotnost ve výuce: příručka pro učitele se souborem úloh.* [online]. Praha : NÚ, divize VÚP, 2011. [cit. 2015.03.10]. Dostupné na: http://www.vuppraha.cz/wp-content/uploads/2012/01/Prirodovedna_gramotnost.pdf ISBN 978-80-86856-84-1.

JŮVOVÁ, A. 2006. Měření didaktické vybavenosti učebnic přírodopisu pro šestý a sedmý ročník základní školy. In MAŇÁK, J. et al. *Učebnice pod lupou.* 1. vyd. Brno: Paido, 2006. 123 s. Pedagogický výzkum v teori a praxi 4. ISBN 80-7315-124-3. s. 97 – 106.

KAŠČÁK, O. – PUPALA, B. 2011. Pisa v kritickej perspektíve. In *Orbis scholae.* ISSN 1802-4637, 2011, roč. 5, č. 1, s. 53–70.

KNECHT, P. – JANÍK, T. 2008. Transformace, artikulace a reprezentace vzdělávacího obsahu v učebnicích: k roli didaktických znalostí obsahu autora učebnice. In KNECHT, P. – JANÍK, T. a kol. *Učebnice z pohledu pedagogického výzkumu.* Brno : Paido, 2008. 196 s. ISBN 978-80-7315-174-4. s. 91-105.

LAUGKSCH, R. C. 2000. Scientific Literacy: A Conceptual Overview. In *Science Education.* ISSN 1098-237X, 2000, Vol. 84. Issue 1, p. 71–94.

MAŇÁK, J. 2007. Učebnice jako kurikulární projekt. In MAŇÁK, J. – KNECHT, P. (eds.) *Hodnocení učebnic.* Brno : Paido, 2007. 140 s. ISBN 978-80-7315-148-5. s. 25-30.

OELSZLAEGER, B. 2007. *Jak uczyć uczenia się? Środki i metody kształcenia samokontroli i samooceny w edukacji wczesnoszkolnej.* Kraków: Oficyna Wydawnicza „Impuls", 2007. 276 s. ISBN 978-83-7308-658-6.

OELSZLAEGER, B. 2011. Uczenie się uczniów klas początkowych. In ADAMEK, I., ZBRÓG, Z. (red.) *Wczesna edukacja wobec wyzwań współczesności*. Kraków: Wydawnictwo LIBRON, 2011. 294 s. ISBN 978-83-62196-20-3. ss. 31-49.

PALEČKOVÁ, J. – TOMÁŠEK, V. 2005. *Učení pro zítřek: výsledky výzkumu OECD PISA 2003*. Praha : ÚIV, 2005. 98 s. ISBN 80-211-0500-3.

PANÁKOVÁ, G. 2010. Zdravá výživa v učebnicích přírodovědy - pojmová analýza [online]. 2010 [cit. 2015-03-15]. *Diplomová práce*. Masarykova univerzita, Pedagogická fakulta. Vedoucí práce Petr Knecht. Dostupné na http://is.muni.cz/th/136201/pedf_m/.

PISA 2006, Slovensko. 2007. Národná správa. Bratislava: Štátny pedagogický ústav, 2007.

PODROUŽEK, L. 1999. *Předměty o přírodě a společnosti v primární škole*. Plzeň : Západočeská univerzita v Plzni, 1999. 119 s. ISBN: 80-7082-536-7.

Rámcový vzdělávací program pro základní vzdělávání. 2007. [online]. Praha: Výzkumný ústav pedagogický v Praze, 2007. 126 s. [cit. 2015-03-15]. Dostupné na

http://www.vuppraha.cz/wp-content/uploads/2009/12/RVPZV_2007-07.pdf.

SIKOROVÁ, Z. 2010. *Učitel a učebnice: užívání učebnic na 2. stupni základních škol*. Ostrava: Ostravská univerzita v Ostravě, Pedagogická fakulta, 2010. 127 s. ISBN 978-80-7368-923-0.

STRAKOVÁ, J. et al. 2002. *Vědomosti a dovednosti pro život. Čtenářská, matematická a přírodovědná gramotnost patnáctiletých žáků v zemích OECD*. Praha : ÚIV, 2002. 111 s. ISBN 80-211-0411-2.

SVOBODOVÁ, J. – SLÁDEK, P. 2008. Přírodovědné aktivity ve školním vzdělávání. In ŘEHULKA, E. (eds.) *Škola a zdraví 21, 3/2008 Praxe současné školy a výchova ke zdraví*. 205 s. ISBN 978-80-7392-042-5. s. 41 – 46.

ŠIMIK, O. 2012. *Utváření obsahu přírodovědné výuky na 1. stupni ZŠ v konstruktivistickém pojetí - výzkum tematického celku voda*. Ostrava: Ostravská univerzita v Ostravě, 2012. 129 s. ISBN 978-80-7464-223-4.

ŠTECH, S. 2011. PISA – nástroj vzdělávací politiky nebo výzkumná metoda? *Orbis scholae*. ISSN 1802-4637, 2011, roč. 5, č. 1, s. 123-134.

ŠVEC, V. – FILOVÁ, H. – ŠIMONÍK, O. 2003. *Praktikum didaktických dovedností*. Brno : Masarykova univerzita v Brně, 2003. 90 s. ISBN 80-210-2698-7.

TOLLINGEROVÁ, D. 1986. *K teorii učebních činností*. Praha: Státní pedagogické nakladatelství, 1986.

VACULOVÁ, I. – TRNA, J. – JANÍK, T. 2008. Učební úlohy ve výuce fyziky na 2. stupni základní školy: vybrané výsledky CPV videostudie fyziky. In *Pedagogická orientace*. ISSN 1805-9511, 2008. roč. 18, č. 4. s. 59–79.

VESELSKÝ, M. – HRUBIŠKOVÁ, H. 2009. Zájem žáků o učební předmět chemie. In *Pedagogická orientace*. ISSN 1211-4669, 2009, roč. 19, č. 3, s. 45–64.

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