Research Insights
Изследователски проникновения

ANALYSIS OF THE BULGARIAN NATIONAL CURRICULUM ON THE SUBJECT "MAN AND NATURE" IN 4TH GRADE AND THE TEXTBOOKS IN THE CONTEXT OF THE TIMSS 2015 FRAMEWORK: A COMPARATIVE ANALYSIS OF THE CONTENT AREA

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Abstract. Bulgaria is on the verge of its first 4th graders' participation in the TIMSS 2015 (Trends in International Mathematics and Science Study) assessment. That is why the analysis of the Curriculum and the representative textbooks is of extreme significance. It is of utmost importance to identify the areas of coincidence, as well as those, where there is a discrepancy in order to align it with the TIMSS 2015 framework. In an attempt to provide such information, in the current article, a brief content analysis is made, and some problem areas are outlined. This could lead to reconsidering the Bulgarian National Curriculum and the respective textbooks in order to improve children's performance and to develop their knowledge and practical skills.

Keywords: primary science, curriculum, assessment, TIMSS 2015 Framework

Introduction

Raising informed future citizens, who are proficient in science, is undoubtedly a vital part of any educational system, as students are to become responsible citizens. Making informed decisions, based on the facts and scientific understanding and distinguishing facts from fiction are skills, enabling not only boosting economy, but also raising the awareness of the major environmental issues. Achieving this goal is only feasible, if the children have the chance to satisfy their curiosity and start observing, exploring and learning science effectively from the early grades. Therefore, the role of the Curriculum on the subject "Man and Nature", the aims and the content learned, are significant for the children's development as future informed citizens.

On the other hand, Bulgaria is on the verge of its first 4th graders' participation in the TIMSS 2015 assessment. That is why, the analysis of the Curriculum, and the representative textbooks are of extreme importance. It is of greatest significance to identify the areas of coincidence, as well as those, where there is a discrepancy in order to align with the TIMSS 2015 framework. In an attempt to do this, a descriptive analysis, content analysis

and comparative analysis are made. The results are represented in tables and graphics, showing the coincidence between the Bulgarian National Curriculum on the subject "Man and Nature" in 4th grade and the TIMSS 2015 framework. A comparison between the TIMSS 2015 Content areas, the respective curriculum and textbooks are done. Some problem areas are identified and recommendations for aligning the curriculum with the TIMSS 2015 framework are suggested. This would enable the students to develop their knowledge, skills and attitudes and to improve their performance.

Overview of the Bulgarian National Curriculum on the subject "Man and Nature" (4th Grade): Content area

According to the Bulgarian National Curriculum on the subject "Man and Nature" (4th grade), the broad aim of the curriculum is to satisfy the children's necessity to learn and to orientate in the environment, as well as to continue the overall pupil's personal development (Ministry of Education and Science, 2003). In order to achieve this goal, the educational process should provide the children opportunities to:

– Develop their intellectual skills to think conceptually, logically, creatively and to take decisions, necessarily for living in a fast-changing, high-technology society, based on knowledge about the properties of the objects and substances; the Earth as a planet of the Solar System; the movement of the objects and organisms; the use of different types of energy; the life processes; the diversity of life organisms and their classification; the life cycles; the diversity of environments and the organisms' adaptation to these environments; the human's development and the relationship between the human health and the conditions of the environment.

– Develop the skills of communication through using verbal, written, table, symbolic and graphic forms for presenting information.

– Stimulate positive attitude towards the nature – interest, impartiality, criticism, curiosity, desire for searching evidence.

– Working out cognitive and practical skills – choosing, distinguishing, comparing, measuring, defining, using available sources of information, grouping according to definite criteria, posing a problem, reporting results from experiments, making conclusions, caring for personal health, caring for animals, plants, etc.[1)].

In order to achieve the stated goals, the National Curriculum encompasses six broad content areas:

1) Property and uses of the substances.
2) Movement and energy.
3) The Planet Earth.
4) Life processes in plants and animals.
5) The diversity of living nature.
6) Man and environment.

There are also expected results, which are defined in these topics and are further developed in the textbooks on the subject "Man and Nature" in 4th grade. They ensure

that the expected outcomes are met, and the children have mastered the knowledge and skills, necessary to advance in science in the next grades. The content in the Curriculum ranges from physical science to life science and human health, thus enabling the pupils to broaden their knowledge and to acquire important cognitive and practical skills. The question is whether the knowledge and skills, implemented in the curriculum are a guarantee for excellent outcomes and achievements in the TIMSS 2015 assessment. Because Bulgarian 4th graders will participate in the TIMSS Assessment for the first time in 2015, it is of utmost importance to find out whether and to what extent the National curriculum is aligned to the TIMSS 2015 Content Framework.

Overview of the TIMSS 2015 Framework in Primary Science (Content domain)

The TIMSS international assessment of students' achievement in science (4th grade) consists of about 175 items, together with a set of questionnaires, gathering information about the educational and social context for achieving. It is a well-known and reliable assessment, which is indicative of the representative countries' progress in mathematics and science.

In 4th grade, the science framework for the TIMSS 2015 assessment is organized around three main content domains: Life Science, Physical Science and Earth Science (Mullis & Martin, 2013). Each content domain includes one or more major topics, which describes the specific objectives that students should master. The verbs, used in defining these objectives are intended to represent the typical performances, expected of fourth-grade students. In this way, life science is represented by *five major topics*:

– Characteristics and life processes of organisms;
– Life cycles, reproduction, and heredity;
– Organisms, the environment, and their interactions;
– Ecosystems; and
– Human Health (Mullis & Martin, 2013).

Physical science encompasses three broad themes:

– Classification and properties of matter and changes in matter;
– Forms of energy and energy transfer;
– Forces and motion (Mullis & Martin, 2013).

Earth science includes three main topics:

– Earth's structure, physical characteristics, and resources;
– Earth's processes and history;
– Earth in the solar system (Mullis & Martin, 2013).

The Framework for TIMSS 2015 also assesses science practices, which are fundamental for all science disciplines and which are presented in many countries' curricula. Since the scientific practices are related to the content domains, they cannot be assessed separately. That is why some of the content domain items include science practices. They encompass a wide range of skills, such as: asking questions,

based on observations; generating evidence; working with data and answering a research question (Mullis & Martin, 2013).

All these aspects of TIMSS 2015 framework provide an explicit and in-depth opportunity for assessing children's attainment. They also give a notion of the overall achievement of certain countries, the progress or the decline of the representative countries' performance (TIMSS & PIRLS, 2011). Therefore, it is vital for every country to align its curriculum, textbooks, educational process and evaluation of the aspects, assessed in the TIMSS 2015 framework.

Comparison between the Bulgarian National Curriculum on the Subject "Man and Nature", 4th Grade, the textbooks and the TIMSS 2015 Framework Content Domain

In order to find the similarities and differences in the content area of the Bulgarian National Curriculum on the Subject "Man and Nature", 4th grade and the Content domain in the TIMSS 2015 framework, a descriptive analysis, content analysis and comparative analysis are made. According to the results, there are significant differences in some areas, while others are well-developed and almost entirely represent the content domain, included in the TIMSS 2015 framework (Table 1, Figure 1).

Table 1. Comparison between the TIMSS 2015 framework and the Bulgarian National Curriculum on the Subject "Man and Nature", 4th grade

TIMSS 2015 Framework, 4th Grade	**Bulgarian curriculum on the subject "Man and Nature", 4th grade**	**Coincidence**
Life science Characteristics and life process of organisms; Life cycles, reproduction and heredity; Organisms, environment, and their interactions; Ecosystems; Human health.	**Life science** Life processes in plants and animals; Diversity of living nature. Man and its environment.	**Almost entirely**
Physical Science Classification and properties of matter and changes in matter; Forms of energy and energy transfer; Forces and motion.	**Physical Science:** Properties and uses of the substances; Motion and energy.	**Partial**
Earth Science Earth's structure, physical characteristics, and resources; Earth's processes and history; Earth in the Solar system.	**Earth Science** The planet Earth.	**Partial**

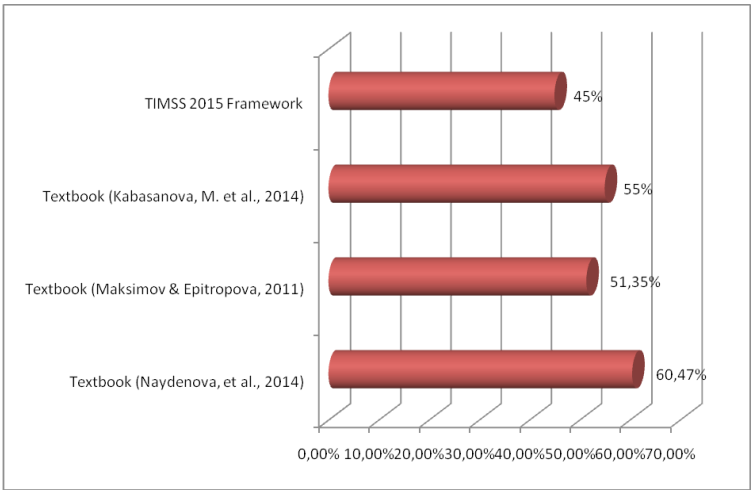

Fig. 1. Life Science Content domain in the Bulgarian textbooks on the subject "Man and Nature", 4th grade and the TIMSS 2015 Framework in Percentages

The results, presented in table 1 and fig. 1 are indicative for the overall educational process on the subject "Man and Nature" and the content domains, included in the Bulgarian National Curriculum, the textbooks and the international assessment TIMSS.

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According to the results, the content area "Life Science" is as well represented in the Bulgarian National Curriculum and textbooks, as in the TIMSS 2015 Framework. Although the children learn how to sort the organisms and they are familiar with some taxonomies (such as: insects, fishes, amphibians, reptiles, birds and mammals), in the Bulgarian National Curriculum on the Subject "Man and Nature", 4th grade the classification of the animals according to their backbones (or lack of backbones) is not included. At the same time, in some textbooks (for example: the textbook, written by Kabasnova, M. et al., 2014) this classification is given. This fact is due to the authors' decision to upgrade the standards in the curriculum and it is optional. Some other textbooks (for instance: Naydenova, L. et al., 2014) do not include this classification, as it is not required by the National Curriculum on the subject "Man and Nature" in 4th grade. The humans' bodily responses to exercise and to high and low temperature are also not represented in the National Curriculum and they are not further developed in the respective textbooks.

Another important aspect of the TIMSS 2015 Life Science Content Domain, namely the concept of heredity is also underestimated in the Bulgarian National Curriculum. According to the TIMSS 2015 Framework, the 4th grade students should be able to "recognize and explain that some features that are inherited from parents help living things survive, such as the waxy coating on some plants' leaves, helping the plants stay alive in dry climates or animals coloring helping it hide from predators" (Mullis & Martin, 2013). These features are familiar to the children, as they learn how the animals adapt to the diverse environments in order to survive or to escape from the predators. Nevertheless, the concept of heredity is not presented and the related skills for identifying and describing different stages that increase the numbers of offspring that survive, such as a plant producing many seeds or mammals caring for the young, are not learned.

All the above-mentioned differences could lead to some difficulties in dealing with these items and would decrease the final scores and the overall performance of the Bulgarian 4th grade students.

Another important area in the TIMSS 2015 framework is "Physical Science". It includes the following sub-topics: classification and properties of matter and changes in matter; forms of energy and energy transfer and forces and motion and represent 35% of the overall items. As it is shown in Table 1 and fig. 2, this content area represents between 18.6% and 30% of the topics, included in the Bulgarian textbooks. There is also partial coincidence between the National Curriculum and TIMSS 2015 framework. Examining closely these differences, we could find that the TIMSS 2015 framework requires the children to "describe examples of mixtures and explain how they can be physically separated (using sifting, filtration, evaporation, or magnetic attraction)". Although, the children are familiar with these methods, they learn them in a different context. For example, when studying the topic for water purity, students learn about the sifting and filtration. Actually, evaporation is a concept, which emerges in relation to the topic of the water cycle and magnetic attraction in the lesson for forces and motion.

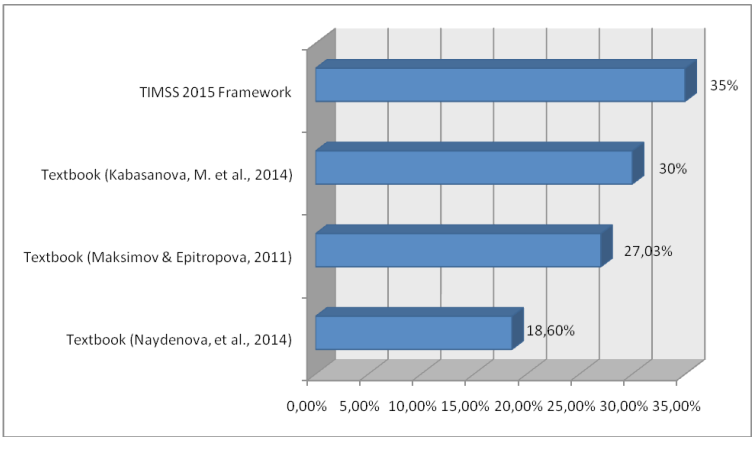

Fig. 2. Physical Science Content domain in Bulgarian textbooks on the subject "Man and Nature", 4th grade and TIMSS 2015 Framework in Percentages

Another problem is the lack of activities, connected with the identification how quickly the materials dissolve in a given amount of water and the comparison of the concentrations of two compounds with a different amount of solute and solvent. This is a gap, which could lead to decrease in students' performances both in the test items and in the practical tasks.

The next area, where pupils' knowledge might be incomplete, could be related to the skills for identifying observable changes in materials with different properties. According to the National Curriculum and the textbooks, children learn only about the burning. The other processes like decaying, rustling and cooking are not included in the learning material in 4th grade. Despite the fact, that children might have experience with these processes, the lack of content standards in the National curriculum and respectively in the textbooks, could lead to some difficulties for the children, dealing with these items in the TIMSS 2015 Assessment.

Another problem area in "Physical Science" Content Domain is the fact that children are nearly unaware of the behavior of light, as they virtually do not study the physical phenomena like shadows, reflections and rainbows. They are not even mentioned in the curriculum on the subject "Man and Nature" in 4th grade and consequently, are not well represented in the textbooks. The topics for lights and shadows are included among the learning material about the Solar system and the alternation of day and night.

As far as the electric-powered energy in a system and simple electric-powered systems are concerned, the children in 4th grade are not familiar with them. The electric-powered pathway and the electric-powered circuit are not included within the curriculum at all, and definitely this would cause problems, when it comes to these TIMSS test items.

The last main content domain in TIMSS 2015 Framework is "Earth Science". Although this area is well represented in the textbooks, there is a partial coincidence between the National Curriculum and TIMSS 2015 Framework (table 1, figure 3).

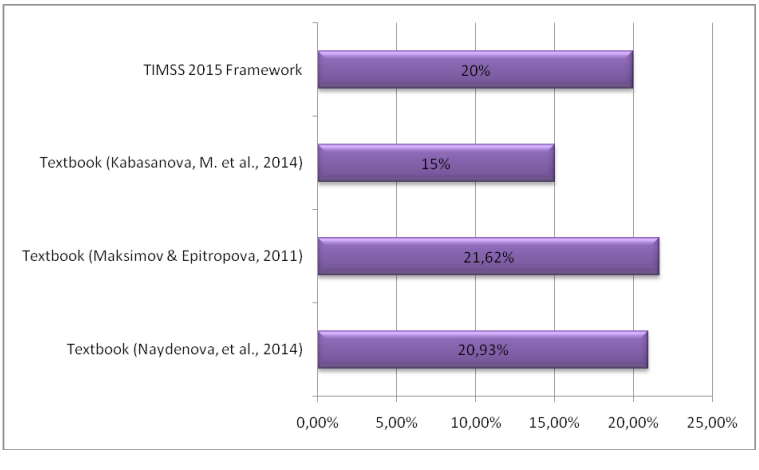

Fig. 3. Earth Science Content domain in the Bulgarian textbooks on the subject "Man and Nature", 4th grade and the TIMSS 2015 Framework in Percentages

According to the Content Domain in TIMSS 2015, students should be able to recognize that wind and water change the landscape. This skill is underestimated in the Bulgarian National Curriculum and consequently, in the textbooks, as they present only the process of efflorescence. The changes, which water causes, are not included in the learning material.

The greatest mismatch, however, could be found within the area of Earth's Processes and History. The most standards, included in the TIMSS 2015 framework are either not included in the National curriculum, or they are a section from the learning material on the subject "Man and Society" in 4th grade. This is the case with the skill to recognize that water in rivers and streams flows from mountains to ocean or lakes. These topics, as well as the information about the geographical regions, their characteristics and natural resources, are a part of the subject "Man and Society". However, some aspects of the weather conditions and temperature are not included, neither in the subject "Man and Nature", nor in the subject "Man and Society". For example, the information about the weather variations in certain geographical regions is not studied in 4th grade. Moreover, the students could not suggest how the seasonal changes vary with the location, because they are expected to explain only weather and seasons' changes.

Another area, where there is a discrepancy between the National curriculum and the TIMSS 2015 framework is related to the topics of remains (fossils) of animals and plants that lived on Earth. The information about the fossils, their location and the skills to make deductions about the Earth's surface are not taught in 4th grade in Bulgaria. More attention is paid on water, air and soil protection, their purity and usage.

Conclusion

Considering the above-mentioned information, it could be concluded that most of the topics in the TIMSS 2015 content domain are included in the Bulgarian National Curriculum. However, there are areas, where children's knowledge and skills are not sufficient for the successful completion of the TIMSS 2015 assessment. For instance, in Earth Science Content Domain: Earth's processes and history, in Physical Science Content Domain: Forms of Energy and Energy Transfer, the processes decaying, rusting and cooking, as well as the concept of heredity in Life Science Content Domain. Other concepts and skills are presented in a different context in the Bulgarian National Curriculum, in comparison with the TIMSS 2015 framework. For example, the topics of water, air purity and soil are included in Earth Science Content domain in the TIMSS 2015 framework, while in the Curriculum they are represented in the main topic – properties and uses of the substances. The same is true for the topics of uses of the everyday resources. In the TIMSS 2015 framework, this topic is included in the Earth Science Content

Domain, whereas in the Bulgarian Curriculum – in Physical Science, Subtopic Movement and Energy.

In summary, there are areas, where the National Curriculum should be complemented and others, where new contexts for the desired knowledge and skills are needed. This would enable children not only to succeed in the TIMSS 2015 assessment, but also to develop their knowledge and practical skills.

NOTES

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