

USING THE IEA TIMSS TESTS TO COMPARE PUPILS' SCIENCE EDUCATION ACHIEVEMENTS AT REGIONAL AND SCHOOL LEVELS

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Abstract. The task of research was to find out if the TIMSS (Trends in Mathematics and Science Study) tests could be used to compare the average achievements of schools at regional level. All eight-formers of the Valmiera (Latvia) region participated in the investigation.

The study showed that on average, the achievements of the schoolchildren of the Valmiera region are more considerable than those at national level in general. Moreover, the representatives of the city site rather than the participants of the rural area were more successful in the Valmiera region as well as throughout the country. However, analysis indicates that some schools of the rural area have achieved impressive results while knowledge of a number of the learners of the city remains rather poor. The data is important to education leaders of the region because school situation and the results of this research can help to carry out the assessment of every school. The obtained information regarding pupils' performance in each of the subject content groups is essential for schools. In general, we may consider that a parallel TIMSS study undertaken in one of the regions of Latvia has been very successful and education leaders, school principals and teachers of the area received valuable information.

Key words: science education, international comparative science study, TIMSS, achievement.

Introduction

The abbreviation of the TIMSS has widely been known for all scientists since 1995. It meant the Third International Mathematics and Science Study until 1999, but since the year 2000 it has been called Trends in Mathematics and Science Study. This is the largest international comparative education study, which has been dealing with mathematics and science education in a large number of countries for more than ten years. The TIMSS has gained vast support of scientists and politicians. The study conducted three surveys (in 1995, 1999 and 2003) which involved more than one million pupils (Beaton et al., 1996; Martin et al., 1997; Martin et al., 1998; Martin et al., 2000). Latvia also took part in all three events of the TIMSS the results of which have been widely analyzed (Geske, 1999; Geske, 2000; Geske, Grinfelds and Kangro, 2001; Geske, Kangro, 2002)

Though the achievement tests that are applied for comparison and assessment of different sub-systems of education of the study are oriented towards comparisons on a system level, experience of some countries (e.g., USA and Canada) exists. We put forward a task for ourselves to find out if these international tests could be used for the comparison of schools. One of the administrative regions of Latvia (Valmiera region) was chosen for the study.

The eight-formers' survey tests of the year 1999 were used in Latvia. They were performed by almost four thousand schoolchildren within the TIMSS study. The tasks included multiple choice assignments, short (some words only) and extended answers (pupils had to provide rather lengthy explanations). Both types of the tasks which are short and extended answers are to be coded with appropriately formulated codes that exactly agree with assessment. The experts that coded learners' answers in the 1999 TIMSS study helped us in our Valmiera region study.

The tests include the items of science and mathematics. According to content, science items were divided into six groups: Earth Science, Life Science, Physics, Chemistry, Environmental and Resource Issues, Scientific Inquiry and Nature and Science. All items of maths and science were put into 8 different brochures. A high number of brochures ensure not

only a total large number of tasks which cover all the above mentioned content areas (150 science items and the same number of items in mathematics, approximately) but also do not provide a possibility of cribbing.

We appreciate mutual agreement with the Valmiera region. Maris Ruberts, the head of the Education Board, was very supportive and showed great interest in the study. The territory is 2400 square kilometres, population is about 60 000 inhabitants, the regional centre is Valmiera, a comparatively large town with 30 thousand inhabitants. Valmiera is situated 110 km from Rīga. There are also two smaller towns in the region – Rujiena (4000 inhabitants) and Mazsalaca (2000 inhabitants) and 22 villages with the population ranging from 500 to 3000 people.

The structure of regional schools corresponds to the number of the inhabitants in the territorial placement of the schools. However, it should be taken into consideration that frequently the pupils of the Valmiera region come from the families of a higher social economic status and are greatly interested in education. They often choose a “centripetal” mode of education acquisition and learn either in the regional centre or in Riga which is only 110 km away from Valmiera.

The eighth-formers of basic and secondary schools from the whole Valmiera region regardless of their age participated in the study. A general core of the study was made up by 717 pupils from 21 general comprehensive schools (including one correction and re-education institution which is attended by schoolchildren after ruling of the Court). The language of the instructions of all participating schools is Latvian except an instruction of one school which is Russian. The pupils of this school performed the tests and filled in the questionnaires in Latvian (the instruments of the TIMSS-R were not translated into Russian). The study of science achievements of the basic school pupils in the Valmiera region divided schools in the following strata (see table 1):

- urbanization level – Valmiera schools / schools of other towns/ rural area schools;
- school type – basic schools / secondary schools.

Table 1.Division of Valmiera region schools in strata.

Stratum	Number of participating schools	Number of pupils
All schools	21	717
Valmiera schools	5	414 (55%)
Schools of other towns	2	100 (14%)
Rural area schools	14	203 (28%)
Basic schools	12	170 (76%)
Secondary schools	9	547 (24%)

Results of Research

Pupils’ achievements in science in the TIMSS-R study are expressed in numbers (the average value 500 with a standard deviation 100) (Martin et al, 2000). The achievements in science of the Valmiera region pupils were measured with a help of this method.

The structure of the pupils’ achievement test does not allow to compare individual results, and therefore the achievements in science of the eight-formers of the Valmiera region

were compared at school level (see figure 1). The results of the 1999 TIMSS-R study were used for the international comparison.

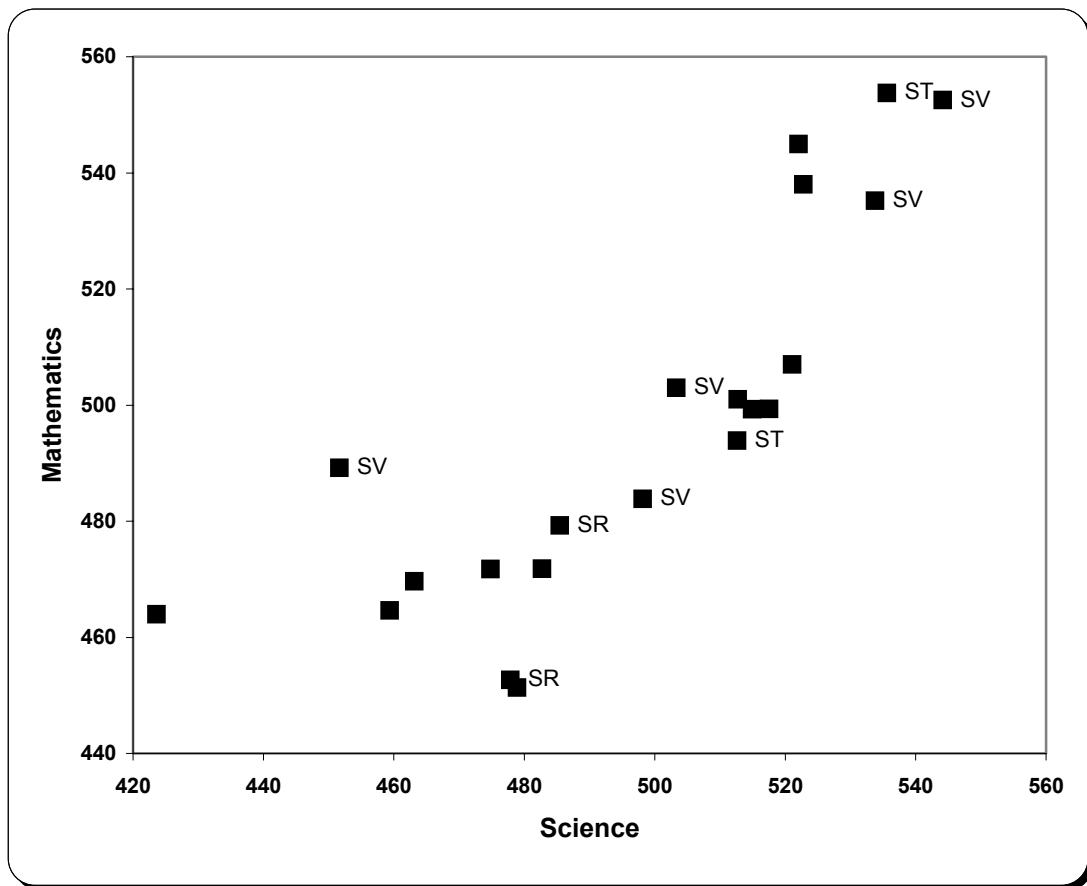


Figure 1. Distribution of school achievements (SV – Valmiera secondary schools, ST – secondary school of other towns, SR – rural area secondary schools).

The dispersion of science achievements of the eighth-formers of the Valmiera region varies from 423 (correction and re-education institution) to 544 points. The results of 10 schools (a half) is higher than Latvia's average in the TIMSS-R study but the achievements in science of 13 schools of the Valmiera region are higher than the international average which is 488 points. If compared the results of the eighth-formers of the Valmiera region with those of the TIMSS-R on the international level, conditionally the Valmiera region would be in the 20th place among 38 countries leaving behind Latvia, Lithuania, Italy and other countries (Geske, 2000). In general, the average achievements in science of the Valmiera region pupils are higher than the international average in the TIMSS-R study by 19 points.

As the study simultaneously assessed the achievements in science and mathematics, mutual links between these two subjects should be interesting to compare. Figure 1 shows that school achievements in science and mathematics strongly correlate (correlation coefficient 0.61), i.e., schools having high achievements in mathematics also have high achievements in science and vice versa. An interesting point is that the schoolchildren of the school with the Russian language instruction showed comparatively high results in mathematics and considerably low results in science (the school was in the second place agreeably to the worst average achievements in science). Obviously, the tasks including vast text material in Latvian presented pupils more difficulties than mathematics tasks with numerical language and formulas. However, there is no reason to think that one needs very different skills to acquire mathematics and science. Also the achievements of pupils from correction and re-education

institutions are not typical as to its composition this is a special school (the school with the worst achievements in science but not in mathematics).

Taking into consideration the influence of urbanization faction, pupils' average achievements is seen in Figure 2. The difference between city site and rural area schools is significant. The obtained results show that on average the pupils of the rural area school have not possibilities to receive such good basic education as the schoolchildren of the rural area. Thus, the representatives of the rural area schools are the worst at entering Grammar school, secondary school or other institutions of higher education. At the same time Figure 1 shows that there are some basic schools in the rural area where achievements are very high. Hence, it should be noticed that the obtained results of each of the schools are individually assessed.

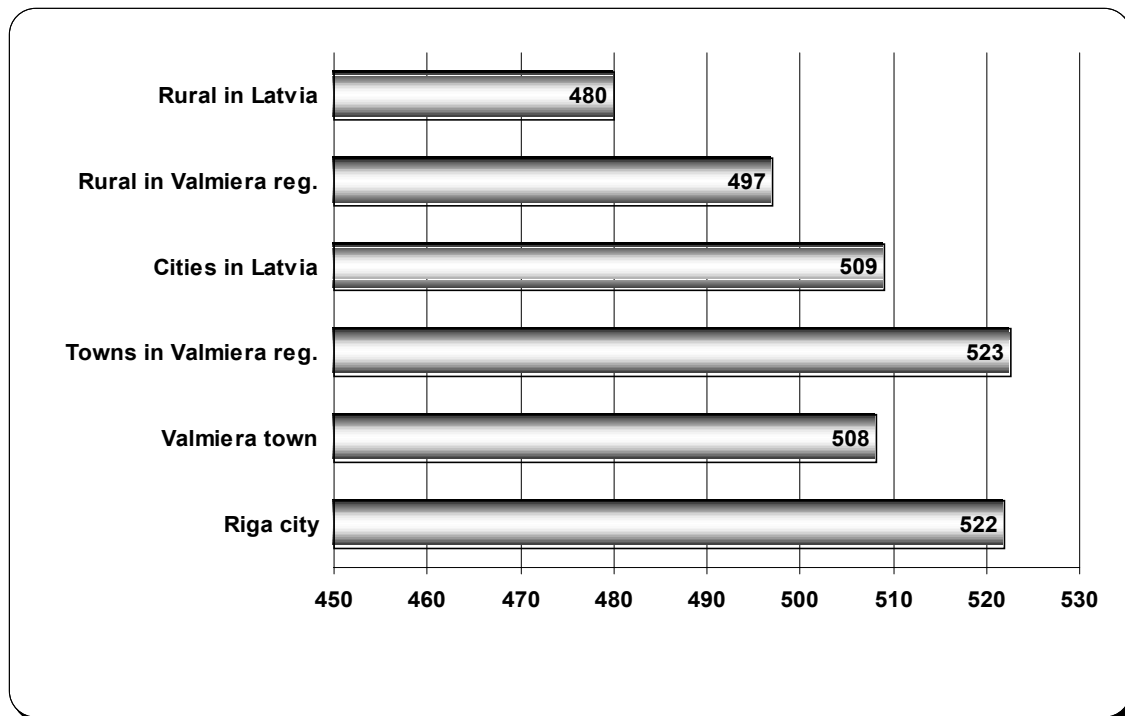


Figure 2. Distribution of the Valmiera region pupils' achievements in science depending on the urbanization level.

On average, though the achievements of the Valmiera schoolchildren are quite high they considerably differ and vary from medium to very good. Unofficial school rating, possibilities and principles of school staffing and recruiting are notorious to any person who perfectly knows the system of Valmiera schools. However, this study confirms that the school having high unofficial rating produces comparatively low results and vice versa.

The pupils of two small towns of the Valmiera region came up with good results that actually are considerably higher than the average results of the Valmiera region and even a bit higher than the achievements of the pupils from Rīga (Geske, 2000). However, it should be noted that these are small schools and do not give significant contribution within the whole region.

The comparison of the results of the eighth-formers learning in secondary, Grammar and basic schools suggests (Figure 3) that there is a considerably big difference in achievements in favour of secondary and Grammar school pupils. This is characteristic to the whole country, and therefore we should think that basic schools are facing some serious work-related problems. It should also be mentioned that all basic schools are situated on the countryside that goes together with the previously mentioned division of schools according to the urbanization level.

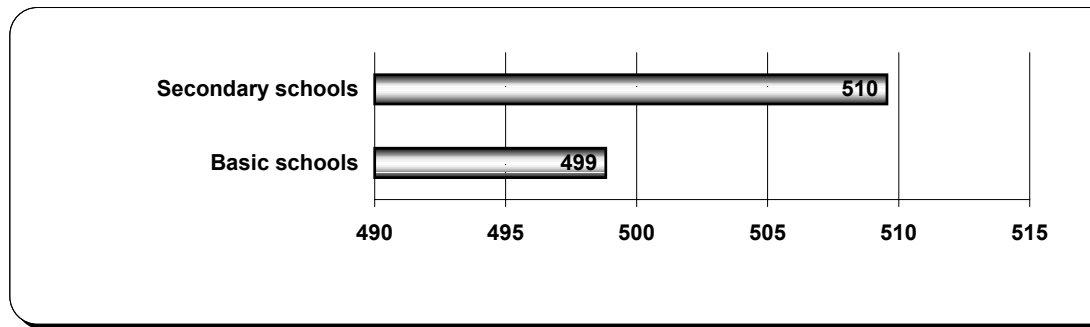


Figure 3. Distribution of the Valmiera region pupils' achievements in science according to the type of a school.

According to content, science tasks in pupils' achievement tests were divided into six groups: Physics, Chemistry, Life Science, Earth Science, Environmental and Resource Issues, Scientific Inquiry and Nature of Science. Figure 4 demonstrates the achievements in science of the Valmiera region pupils regarding different content groups. Pupils' achievements were assessed by counting right answers in percentage in each content group agreeably to the methods of the international study.

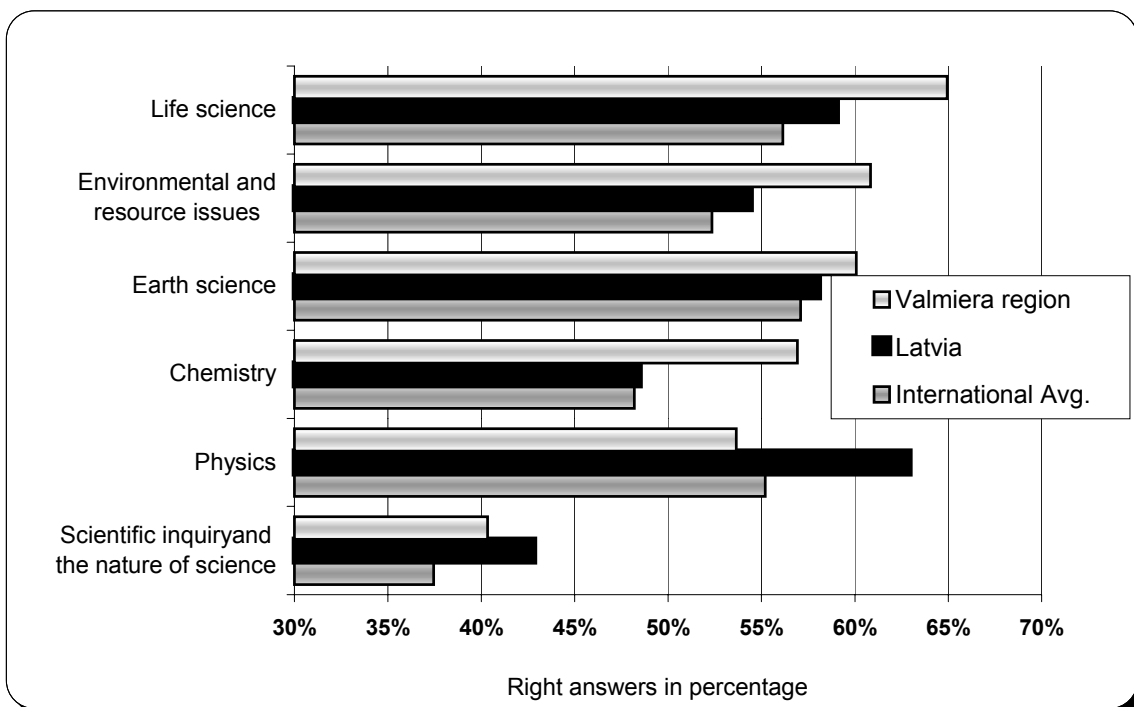


Figure 4. Achievements in science in different content groups.

The eighth-formers of the Valmiera region showed the highest percentage (65 %) of the right answers in the group of biology tasks which is better than in Latvia, in general, and higher than the international average. Biology rather than other branches of science is paid more attention in basic school in Latvia as it is being taught already at junior basic school.

Environmental and resource issues deal with ecology problems of a contemporary world and nature protection issues. The pupils of the Valmiera region show a considerably higher percentage of right answers (61 %) in this group than the average showings of Latvia and international average (54% and 52% respectively).

The Earth science is an individual subject in many countries. These topics are included in the content of geography in Latvia. The achievements of the Valmiera region pupils in the group of the earth science tasks are similar (a bit higher) to Latvia's and international average.

Though chemistry is taught for the first year in form 8, the percentage of the right answers given by the Valmiera region pupils is 57% that is much higher than Latvia's and international average (47%).

Physics is a broader field of science than lifeless nature. Traditionally it is taught in forms 8 and 9 of Latvia's basic school. From all groups of the tasks of the TIMSS-R study Latvia's schoolchildren showed the highest percentage of the right answers dealing with physics tasks (63%) but the achievements of the Valmiera region pupils is much lower which is only 53% that is worse than the international average (55%).

The last content group is scientific inquiry that includes a scientific world outlook and a cognitive method. Similarly to Latvia's average achievements the pupils of the Valmiera region have reached the lowest result in this group – only 40% of the right answers (Geske, 2000).

Conclusions

The results of the study prove the known data and give detailed and latest information about the schools of the Valmiera region. The average achievements of the city site learners are much higher than those of the rural area representatives. However, the study indicates that the achievements of the schoolchildren from some rural area schools are very high while the success of quite a few schools of the city site is comparatively low. This information is important to the leaders of regional education boards. A concrete situation at school and the results of this study can help them to undertake the assessment of each school individually. The information imparted by the study regarding pupils' achievements in the content group of each subject is essential for schools. In general, we may consider that a parallel TIMSS study in one particular region of Latvia was very successful and education leaders, school principals and teachers of the region received valuable information.

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Резюме

ИСПОЛЬЗОВАНИЕ ТЕСТОВ IEA TIMSS ДЛЯ СРАВНЕНИЯ ДОСТИЖЕНИЙ УЧАЩИХСЯ ПО ПРЕДМЕТАМ ЕСТЕСТВЕННЫХ НАУК НА РЕГИОНАЛЬНОМ И ШКОЛЬНОМ УРОВНЕ

Бенита Багата, Андрейс Геске, Рита Киселёва

Основной задачей данной работы было выяснить – можно ли тесты международного сравнительного исследования образования TIMSS (Trends in Mathematics and Science) использовать для сравнения средних достижений по предметам естественных наук школ отдельного региона страны. Участниками исследования были выбраны все учащиеся восьмых классов одного (Валмиерского) района Латвии.

В ходе исследования было констатировано, что средние достижения по предметам естественных наук восьмиклассников Валмиерского района немного выше, чем в стране в целом. В Валмиерском районе, как и во всей Латвии, средние достижения учащихся городских школ значительно выше, чем средние достижения сельских учеников. Но результаты исследования показали, что есть как сельские школы с очень высокими показателями, так и городские школы со сравнительно низкими показателями. Эта информация важна для районных руководителей образования, и только они могут дать полную оценку каждой школы, учитывая конкретную ситуацию в школе и результаты этого исследования. В ходе исследования полученная информация о достижениях восьмиклассников по отдельным группам задач также является существенной для руководителей школ.

В целом можно считать, что параллельное исследование TIMSS в отдельном регионе Латвии было проведено удачно и районные руководители образования, администраторы и учителя школ получили ценную информацию.

Ключевые слова: естественнонаучное образование, международное сравнительное исследование образования, TIMSS, достижение.

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