

SCIENCE LARGE-SCALE ASSESSMENT ALIGNMENT TO THE REVISED SCIENCE CURRICULUM

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Abstract

The research compared and assessed 6th grade student large-scale assessment item indicators according to the revised competency-based Science curriculum in Latvia, in order to understand what improvements are needed in the large-scale assessment for aligning the national assessments with the new national curriculum, and thus ensuring successful implementation of the educational reform. The theoretical framework of the research was developed by using the frameworks of the Programme for International Student Assessment (PISA), and cognitive level was measured according to the Structure of Observed Learning Outcomes (SOLO) taxonomy.

Keywords: *assessment alignment to curriculum, educational reform, scientific literacy.*

Introduction

Similarly as other countries around the world, Latvia undergoes a nation-wide curriculum reform in general education with an aim to develop 21st century skills. The reform focuses on the development of learners' competencies – the ability to apply knowledge, skills, attitudes and values to various contexts, complex and changing real life situations (OECD, 2016). Scientific literacy is one of the key competencies for the 21st century learner (OECD, 2018), and it is defined as one of the learning goals that should be achieved at the end of the compulsory education in Latvia -Grade 9 (Regulation No.747, 2018).

To support successful implementation of the reform, the alignment of the curriculum with pedagogy and assessment plays a crucial role (Fullan & Quinn, 2015). Previous research (France et al., 2017; Pestovs & Namsone, 2018) indicated that there is a difference between the learning content defined in the national curriculum and the learning content that is assessed in the national tests. Thus, the analysis of national tests and the degree to which the assessment is aligned to the new curriculum characterises success regarding the accomplishment of the reform aims.

The purpose of the research was to review and evaluate 6th Grade national level tests in Science subject for two consecutive years – 2018 and 2019 in the context of the new curriculum. The main aim of the analysis was to gain an insight into the conditions significant for successful reform implementation.

The theoretical framework with regard to the definition of scientific literacy was based on the OECD's (Organisation for Economic Co-operation and Development) PISA

(Programme for International Student Assessment) Science assessment framework, and the definition of the item cognitive demand – on the SOLO (Structure of Observed Learning Outcomes) taxonomy (Biggs & Collis, 1982).

To achieve the purpose, the following research questions were identified:

1. What are the assessment indicators in 6th Grade national tests in Science in 2 years' period in Latvia?
2. Are there any changes between the years?
3. To what extent the aspects measured in the national tests align with the revised curriculum?

Research Methodology

National level tests of years 2018 and 2019 were analysed by specially trained experts, individually and in focus group discussions. Firstly, the assessment indicators were determined individually, and then during several (at least three) iterations in a group setting the assessment indicators were revised and the cognitive level of each item according to the SOLO was defined. Additionally, for several items student answers were analysed to understand what answers were accepted during the marking, as national level tests were administrated and marked internally in schools.

The assessment indicators of national level tests in Science were mapped according to the (a) scientific literacy categories (that represent the new curriculum) and (b) SOLO cognitive levels (I, II, III, IV).

The limitations of the research methodology were that there was an evidence of inconsistency between the item cognitive demand and the school interim marking, which in fact reduces the cognitive demand of the item. For some items experts could not define the assessment indicator and these items were excluded from the research.

Research Results

As Table 1 demonstrates, most assessment indicators in Science national level test in 2019 were identified at SOLO II and I levels, while only 3 items (from 23) were identified at SOLO III level. Assessment indicators for items 19 and 22 were not defined, and items were omitted from the analysis, because of the inconsistency in decisions about assessment indicators. By comparison, from all 30 assessment indicators in Science national level test in 2018 only 1 item was identified at SOLO III level, the rest - SOLO II and I levels (see Table 2).

Table 1. Item assessment indicators of 6th grade national level test in Science, Year 2019.

Item No.	Assessment Indicators	SOLO levels
1.	Calculates the time from minutes to seconds	I
2.	Deduces the Moon phase by modelling	II
3.	Knows why the day and night shifts	I
4.	Knows how to verify that there is air in the room	III
5.	Determines scale according to the stated conditions	I
6.	Knows the necessary equipment for filtering	II
7.	Recognizes the mixture, which can be filtered	I
8.	Recognizes the condition for the faster evaporation	I
9.	Knows what is dissolution	I
10.	Knows how to speed up the dissolution process	II
11.	Compares the numbers to determine the biggest ratio solute in the solution	II
12.	Recognizes the described observation	II
13.	Recognizes common used material properties	II
14.	Determines the distance by extrapolating the linear graphic	II
15.	Deduces the length from the graphic	I
16.	Recognizes a working electric circuit	III
17.	Explains the phenomenon of using observation and gas volume dependence of temperature	I
18.	Knows renewable energy sources	II
20.	Recognizes plant by indications	II
21.	Recognizes parts of plants shown in the figure	II
23.	Predicts in a particular example the three elements of ecosystem dependency and the consequences of one element of change	II
24.	Compares values to make the reliable conclusion	II
25.	Interprets complex graphical information	III

Table 2. Item assessment indicators of 6th grade national level test in Science, Year 2018.

Item No.	Assessment Indicators	SOLO levels
1.	Determines the lowest value by comparing the complex by analysing the information	I
2.	Recognizes the relation between the concepts of "density" and "mass" and "volume"	I
3.	Find the largest number in the table	I
4.	Evaluate the way the data is displayed according to the obtained data	II
5.	Determines the highest value by comparing the complex by analysing the information	I
6.	Reads the values from the bar chart and the value from the graph to complex graphical information.	I
7.	Know that the type of precipitation depends on the temperature.	II
8.	Interprets graphical information in a specific (biology) context, evaluating the relevance of statements to interpretation	II
9.	Reads the volume of liquid using the drawing of a measuring cylinder	II
10.	Recognizes supportive, nervous, circulatory and respiratory systems by image	I
11.	Knows the oceans and seas are saltwater	II
12.	Knows from which side the sunrise takes place in the northern hemisphere of the Earth	I
13.	Reads the largest and smallest sector from the chart	III
14.	Interprets bar chart data in context (astronomy) to form a verbal relationship	I
15.	Knows the Moon Phase succession and appearance	I
16.	Recognizes the smallest value from the bar chart	II
17.	Knows the biggest causes of pollution	I
18.	Knows how to conserve natural resources	I
19.	Knows an example of action that leads to a reduction in air pollution	I
20.	Knows that sunglasses protect your eyes from light and ultraviolet radiation	I
21.	Knows renewables and non-renewable energy sources	I
22.	Knows the change of pole length depending on the time of day	I
23.	Transforms the data in a graphical way	I
24.	Finds and reads information	II
25.	Knows that the experiment should be repeated three times to calculate the mean value	II
26.	Knows that the dependent variable should be changed	II
27.	Finds and reads information	II
28.	Finds and reads literally found different information	II
29.	Determines the appropriate graphical representation according to the scale.	II
30.	Set higher values by analysing complex graphical information	II

Table 3. Alignment between item assessment indicators of 6th grade national level tests in Science and the revised curriculum framework.

	Competence	SOLO level							
		I		II		III		IV	
		Year 2018	Year 2019	Year 2018	Year 2019	Year 2018	Year 2019	Year 2018	Year 2019
Scientific literacy	<i>Explain phenomena scientifically</i>		18, 16, 10, 9, 8, 4		13, 7, 23, 2, 3		17		
	<i>Interpret data and evidence scientifically</i>	3, 14, 22, 23	1	4, 8, 11, 13, 24, 27, 28, 29, 30	21, 20, 14, 11, 15	16	25, 5		
	<i>Evaluate and design scientific enquiry</i>	1, 5, 6	6	7, 9, 25, 26	13, 24				

Assessment indicators of 2018 and 2019 Science national level tests demonstrated inconsistency in two-year period both in scientific literacy competencies and SOLO levels. Most indicators matched with “interpreting data and evidence scientifically”. According to the SOLO levels, during two-year period only 4 items were identified at SOLO III level, and there are no items identified at SOLO IV level, which is critically important for the knowledge transfer and conceptual understanding as student learning result.

Conclusions and Implications

Assessment indicators identified in the national level tests of the two last years match against the three scientific literacy competencies, but to a different extent both in terms of balance, as well as cognitive depth. However, there are considerable changes between the Year 2018 and Year 2019 with regard to the assessment of scientific literacy competencies. For example, in the Year 2018 there are no items assessing student competence to explain phenomena scientifically, but in the Year 2019 there are 12 items assessing it. This leads to the inconsistency of the result interpretations by teachers and policy makers.

Item assessment indicators reveal that the most substantial part of the assessment items assesses lower cognitive skills according to the SOLO. This implicates a huge disparity between the revised science curriculum and the assessment, as one of the main goals of the curriculum reform is to enable students to demonstrate the ability to solve problems and deal with complex situations. Thus, the research indicates the need for a better alignment between the learning content in the new curriculum and the assessment, in order to ensure successful reform implementation.

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