The Growth Dynamics of Achievements in Mathematics: Analysis of International Reasearch

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Mathematics takes a specific place in the education of any country because the opportunities and success of youth in contemporary society are often dependent on their knowledge and skills exactly in the sphere of mathematics. Information about the status quo of mathematics education in a country is gained in an international comparative research on education. The goal of the present research is to reflect the results of the international project "Non-cognitive skills and Singapore learners – international comparison" organized by Singapore National Education Institute about the achievements of 2828 Latvian school learners of grade 9 in doing 12 mathematical sums. These results were compared with the Programme for International Student Assessment (PISA) 2003 research results this, in turn, made it possible to predict the results of the PISA 2012 research in teaching mathematics as well as to evaluate the efficiency of the new standard of education in Latvia in the first six years. The author also considers the causes of the low achievements of Latvian learners in doing sums in mathematics.

Key words: *learners' achievements, mathematics education, international comparative research*

Introduction

Comparative research in education constitutes an important group of the education indicators that may be used to compare the systems of education in the world countries which are so very different (Broks et al., 1998), to assess the degree to which learners who are to leave primary school have mastered knowledge and skills needed for participating in the life of society as well as formulate requirements for improving the system of education in each country.

Two major international comparative studies may be distinguished in mathematics education: the International Association for Evaluation of Educational Achievement (IEA), the international study Trends in International Mathematics and Science Study (TIMSS), and the Organization for Economic Cooperation and Development (OECD) Programme for International Student Assessment (PISA). The major difference of the OECD programme from the research organized by the IEA is found in its conceptual approach, the choice of the means and methodology of research, and the age of the surveyed learners. The OECD PISA research is focused on 15 year-old learners and assesses their mathematical competence instead of checking what they have learned in mathematics. It must be noted that in the PISA research mathematical competence is defined as an individual's ability to formulate, use, interpret mathematical problems in various real life contexts. Mathematical competence includes the ability to reveal regularities by means of mathematics, use the notions, actions, and facts of mathematics to describe, explain, and predict the phenomena and their procedure (Geske et al., 2010).

In 2003, the mathematical competence of school learners on Latvia was in average slightly lower that that of the OECD countries. In the table of mean evaluations, Latvia was listed as number 27. The differences of Latvian school learners' achievements were not statistically significant from those of learners in Norway, Luxemburg, Poland, Hungary, Spain, USA, and Russia.

Competence levels are another important indicator of learners' achievements: from 1 (learners who can answer only clearly formulated questions about a familiar context that includes the respective information, can complete routine activities following clearly expressed indications in precisely formulated situations) up to 6 (learners can conceptualize, generalize, and use the information proceeding from their own investigations and complex problem situation modeling, can relate different sources of information and explanations and flexibly operate with them) (for more information, see, for example, Geske et al., 2010).

Among Latvian school learners, 27% could not do the sums than were more difficult that competence level 1. No more than 3% of learners reached the result that corresponds to the highest competence level 6 (Geske et al., 2004). However, the analysis of the mean results of the PISA 2000 and PISA 2003 showed a radical improvement in the competence quality of Latvian school learners in such spheres of mathematics as space and form (geometry) and variables and functional correlations (algebra). The next PISA research took place in 2006 and showed that in the period from 2003 to 2006 no further improvement of Latvian school learners' achievements was observed, and changes in achievements were not statistically significant (Kiseļova, 2011).

The results of the TIMSS and PISA international research became the basis of the dialogue in the sphere of education policy in Latvia to define and implement education goals in an innovative way, to evaluate and reflect the competences that learners will need in their adult life. As a result, in 2006 in basic education and in 2008 in secondary education in Latvia, a new education standard was introduced including mathematics. The reform of the content of education marked the transition from the acquisition of a large amount of information to the competences of working with information; inclusion of contemporary topics in the content of education and an emphasis on practically applicable ideas and skills; integration of the content of learning and its adjustment across academic subjects; inclusion of topics adapted to the age group of learners in the content of learning (Latvian National Standard, 2006). The new Latvian standard of mathematics fully corresponds to the content of the mathematical link items used in the

PISA tests up to now; approximately half of the standard themes are included in the PISA mathematics link items (Kiseļova, 2011).

Despite the fact that for several years the Latvian national standard of mathematics has fully matched the content of mathematical sums used in the PISA tests until now, the analysis of the results of the PISA 2009 showed that the average achievements of Latvian school learners in this period were considerably lower than those in the OECD countries. Only in some European countries the achievements were worse (Greece, Romania, Bulgaria, Azerbaijan, the Balkan countries). Among all 65 member countries, Latvia ranged no higher than 32–37. A comparison of competence groups has revealed that there are still very few learners in Latvia whose knowledge of mathematics would correspond to the highest level (level 6 has been reached by just 1% and level 5 by only 5% of learners) (Geske et al, 2010).

OECD PISA research is conducted every three years and assesses learners not only in mathematics but also in science, reading, and problem solving, but one of the above-mentioned subjects is evaluated deeper. Mathematics was in the focus of the OECD research last time in 2003 and will be in 2012. Therefore, the evaluation of learners' achievements in mathematics in 2012 will yield more precise results and an opportunity to evaluate the efficiency of the new Latvian education standard after its introduction in the time of the first *six* years (not three as in the PISA 2009). However, analyzing also other comparative international studies with Latvian school learners involved, the correspondence of trends noted by the PISA 2009 to the actual situation may be tested already now.

The Aim of the Study

The present research is part of the Singapore National Education Institute *international study "Non-cognitive skills and Singapore learners – international comparison"* which entailed also checking learners' ability of doing mathematical sums. These outcomes were compared with the Programme for International Student Assessment (PISA) 2003 and 2009 research results which, in turn, made it possible to predict the results of the PISA 2012 research in mathematics education.

The following research questions were set:

1. What are the achievements of Latvian school learners in doing mathematical sums in this international study in comparison with the achievements of the learners of other countries?
2. What and how many Latvian school learner groups that cover the achievements of doing mathematical sums of a similar level and structure may be distinguished according to the data acquired in the study?
3. What socio-demographical differences are there among Latvian school learners in relation to their achievements in doing mathematical sums?

Materials and Methods

Tools

As stated above, the present research is part of the Singapore National Education Institute international study *"Non-cognitive skills and Singapore learners – international comparison"* which entailed an Internet survey for learners with the aim of revealing the similar and different personality traits of learners from various countries, their attitude to mathematics and ability to do mathematical sums.

The present research is based just on 12 mathematical sums of the survey. All mathematical sums were multiple choice or short reply tasks and were taken from the PISA or TIMSS tasks of the previous years (for more information, see Table 2 in the subchapter "Main results"). In their mathematical content, they were from four spheres: 1) space and form, 2) variables and functional correlations, 3) numbers and measures, 4) probability, combinatorics, statistics. The sums were of a different degree of complexity: *tasks of reproducing* (I, 5 tasks) (actions that are relatively known and make use of the acquired knowledge and skills in practice), *tasks of generalization* (II, 5 tasks) (require skills of interpreting, searching for and forming a bond among the different manifestations of the situation), *tasks of mathematical thinking and generalization* (III, 2 tasks) (require understanding a situation and the ability to generalize as well as of a creative approach to a successful use of respective mathematical actions and knowledge) (OECD, 2004).

According to the situation and context, all tasks were divided into four groups: *tasks of everyday life situations* (entailing the context directly related to the routine actions of learners), *tasks of education and vocational situations* (entailing the context related to learners' life in school or at work), *social context tasks* (entailing situations that make learners observe some wider environment context), and *science-related situation tasks* (entailing a more abstract context that may be related to a theoretical situation or a precisely formulated mathematical problem that has no wider context).

For each correctly done sum, a learner received one point. If a sum had not been completed or its solution was wrong, the learner's achievement was evaluated as 0. Exceptions were tasks 2, 7, 11. Each of those tasks contained four subtasks, therefore, for doing each of these tasks a learner could receive from 0 to 4 points. Hence, for a correctly done mathematical test, a learner could maximally score 21 points.

To assess the reliability of the scale, Cronbach's alpha coefficient was calculated for this part of the survey. The value of Cronbach's alpha was 0.582. Thus, it may be concluded that the reliability level of this part of the survey is average and may be used in the research, although the results will not have the highest degree of probability. One reason for the lower reliability of the mathematics test is the small number of items relative to the breadth of the construct (by contrast, the PISA 2003 had 85 mathematics items).

However, it has been noted that if items 2 and 11 are deleted, Cronbach's alpha grows and will reach the value 0.615. Thus, for cluster analysis, only 10 items described below were used (from 1 to 12, except for 2 and 11).

Sample and procedure

From 3083 learners who participated in the research, 2828 grade 9 learners were selected from different regions of Latvia: Latgale (17%), Vidzeme (13%), Kurzeme (12%), Zemgale (12%) and Riga (46%). Of all the participants, 51.8% were female and 48.2% male. 79.2% studied in schools of general education, and 20.8% studied in a school of ethnic minorities. 43.3% of all participants lived in big towns, and 56.7% lived in a small town or the countryside (see Table 1). The learners were not se-

Table 1. ***Learner sampling and the study population distribution into socio-demographical groups***

Socio-demographical indicators		Sampling frequency N (%)	Study population frequency (%)	p value comparing the study sampling with the study population sampling*
Region of Latvia	Riga and region	1304 (46%)	9606 (43.6%)	0.000
	Latgale	482 (17%)	3368 (15.3%)	
	Vidzeme	369 (13%)	2777 (12.6%)	
	Kurzeme	327 (12%)	3382 (15.4%)	
	Zemgale	346 (12%)	2879 (13.0%)	
Sex	Female	1464 (51.8%)	No data	0.060
	Male	1364 (48.2%)		
Education programme	General	2241 (79.2%)	16450 (74.7%)	0.000
	Ethnic minority	587 (20.8%)	5562 (25.3%)	
Urbanization	Urban	1225 (43.3%)	10038 (45.6%)	0.000
	Rural/small town	1603 (56.7%)	11974 (54.4%)	
Birth year	1993 or earlier	99 (3.1%)	No data	
	1994	392(13.9%)		
	1995	2248 (79.5%)		
	1996 or later	97 (3.4%)		

* Group differences were assessed by the chi-square test.

lected for the further research if there were wrong mistaken data indicated, e.g., the ID number of their teacher.

By means of the chi-square test, statistically significant differences were found between the sample and the study population. Indeed, in the study population there were fewer learners from the Riga region and Latgale, but more from Kurzeme, and more learners lived in bigger towns. To find statistically significant differences between the sample and the study population according to sex, it had been assumed that the number of boys and girls had to be equal.

The data collecting process took place in November–December 2010. Mathematics teachers who worked at that time in grade 9 were sent invitations to organize an investigation in their grade. The teachers that agreed to organize the investigation were given an ID number and received instructions by e-mail.

Each learner had to fill in the questionnaire electronically, either in Russian or Latvian, by opening a specially created Internet address. Therefore, each learner needed a computer with the Internet connection as well as some sheets of paper for draft calculations of mathematical sums. While doing the sums they were allowed to use the calculator. If learners could not cope with any of the tasks, they were allowed to skip it.

Thus, basically, the survey was organized in computer labs and was conducted by teachers of mathematics who gave learners instructions on how to fill in the questionnaire. Each learner had to do it independently without consulting the teacher or classmates and only relying on one's own experience and knowledge. Although whole classes were invited to participate in the survey, it was not demanded that absolutely all learners from a particular class tooke part. Participation in this investigation was voluntary.

Main results

The following methods of statistical analysis were used for data processing: the Kolmogorov–Smirnov test to assess the distribution of data, descriptive statistics, frequencies, two-step cluster analysis, the hi-quadrangle criterion as well as Cronbach's alpha to assess the reliability.

According to the Kolmogorov–Smirnov criterion, the data on all items significantly differed from the normal distribution; therefore, a statistical analysis of differences in items was conducted using non-parametrical criteria.

Achievements of Latvian school learners and their international status

First, let us analyze the academic achievements of Latvian school learners in doing 12 mathematical sums. Tables 2 and

Table 2. ***Characteristics of tasks (without subtasks) and the rate of success***

Task number	Task content	Task mathematical content	Task competence group	Task situation and context	Task survey, source, item code	Percentage of learners (%) who did the task correctly	Percentage of learners (%) who failed to do the task
1.	Coloured Candies	Probability	I	Educational and vocational situation	PISA, 2003, M467Q01	34.2	65.8
3.	Bookshelves	Numbers and measures	II	Educational and vocational situation	PISA, 2003, M484Q01	49.9	50.1
4.	Choices	Combinatorics	I	Everyday life situation	PISA, 2003, M510Q01	28.5	71.5
5.	Science Tests	Statistics	II	Educational and vocational situation	PISA, 2003, M468Q01	28.9	71.1
6.	Patio	Numbers and measures	I	Educational and vocational situation	PISA, field trial, M267Q01	16.8	83.2
8.	Space Flight	Numbers and measures	II	Social context	PISA, field trial, M543Q01	45.5	54.5
9.	Earthquake	Probability	III	Social context	PISA, 2003, M509Q01	41.3	58.7
10.	Zedland	Variables and functional correlations	I	Science-related situation	TIMSS, 2006, pg. 106	48.6	51.4
12.	Skateboard	Combinatorics	I	Everyday life situation	PISA, 2003, M520Q02	23.0	77.0
Average						**35.2**	**64.8**

Table 3. ***Characteristics of tasks (with subtasks) and the rate of success***

Task number	**Task content**	**Task mathematical content**	**Task competence group**	**Task situation and context**	**Task survey, source, item code**	**Number of learners who scored points (%)**				
						Points				
						0	**1**	**2**	**3**	**4**
2.	Carpenter	Space and form	II	Educational and vocational situation	PISA, 2000, M266Q01	1.30	27.4	19.0	35.7	16.6
7.	Drug concentrations	Variables and functional correlations	II	Science-related situation	PISA, field trial, M307Q01	60.9	16.1	4.60	17.6	0.80
11.	Payment by area	Numbers and measures	III	Educational and vocational situation	PISA, 2003, M480Q01	10.7	21.1	36.7	23.6	8.00
Average						**24.3**	**21.5**	**20.1**	**25.6**	**8.5**

3 reflect the characteristic features of the mathematical sums (mathematical content, competence group, context), the source of the task and the number of learners who did / failed to do each task. Table 2 contains tasks without subtasks while Table 3 includes three tasks with subtasks.

To summarize the results according to the task competence content, on average 73.5% of learners failed to do tasks of competence group 1, and 47.6% and 34.7% from all learners scored 0 points respectively for doing tasks of competence groups 2 and 3.

For all correctly done tasks, each learner who did the mathematical test could score maximally 21 points. Distributing learners' possible achievements into 7 equal intervals, the number of learners (%) who reached the appropriate level could be determined (see Table 4).

Judging from the learners' achievement in doing 10 mathematical sums (excluding 2 and 11), the raw scale mean was calculated for each country of participants in the Singapore study (Morony, Kleitman & Stankov, 2012). Unfortunately, according to these results, Latvian school learn-

Table 4. ***The number of learners corresponding to the achievement levels of the mathematical test (%)***

Quantitative indicators	**Levels of achievement**						
	0	**1**	**2**	**3**	**4**	**5**	**6**
Mean coefficient of acquisition (%) and scored points	0–14 (0–3)	15–29 (4–6)	30–43 (7–9)	44–57 (10–12)	58–71 (13–15)	72–86 (16–18)	87–100 (19–21)
Number of learners who reached the appropriate level (%)	4.7	29.3	34.6	18.1	8.9	3.7	0.7

Table 5. ***Raw scale mean for students' achievements in the Singapore Project mathematics test and in the PISA 2009***

	Singapore	Korea	Hong Kong	Taiwan	Nether-lands	Denmark	Finland	Serbia	Latvia
Singapore study (raw scale mean)	53.91	50.82	55.87	50.00	53.12	47.77	37.55	37.00	35.02
PISA 2009 (mathematics scores)	562	546	555	543	526	503	541	442	462

ers scored the lowest place among learners from all other countries, whereas according to the PISA 2009 results, the lowest achievements were demonstrated by learners from Serbia (see Table 5).

Groups of learners

To answer the research question about the groups of learners that are equal according to the level and structure of doing mathematical sums, a cluster analysis was made. As mentioned before, only 10 items (from 1 to 12, excluding 2 and 11) were used for the cluster analysis. Using a two-step cluster analysis, all learners according to their results in doing 10 sums were divided into four clusters (see Table 6).

Comparing the four clusters, cluster 2 may be considered the one that comprises learners with the lowest achievements because none of these learners did sums 1–4 as well as 6, 7 and 10, and 12, except for 5, 8, and 9. Hence, the common achievements of learners of cluster 2 are between 0 and 3 points.

The highest achievement in doing 10 sums was demonstrated by learners of cluster 3: this cluster contains the greatest number of learners (%) who did all the sums correctly (except for sum 3). The number of points scored by learners for 10 sums ranges between 5 and 12.

The major differences between clusters 1 and 4 learners lie in the results of doing sum 3: none of the learners from cluster 1 did this sum correctly, whereas all learners of cluster 4 managed to do it (see Table 6). Besides, 67.5% learners in cluster 1 scored up to 3 points for all 10 sums, while

Table 6. ***The number of learners (%) who did a particular sum correctly in each cluster***

	Number of learners (%) in each cluster who did the sum correctly										
Task No. (predictor importance)	1. (0.64)	3. (1.00)	4. (0.18)	5. (0.30)	6. (0.34)	7.* (0.57)	8. (0.23)	9. (0.14)	10. (0.47)	12. (0.41)	Total
Cluster 1 (N_1 = 957, 33.8%)	30.1	00.0	30.8	20.1	8.5	10.4	39.7	37.8	49.6	18.8	1-8
Cluster 2 (N_2 = 386, 13.6%)	00.0	00.0	00.0	12.7	0.00	0.00	38.1	31.9	0.00	0.00	0-3
Cluster 3 (N_3 = 553, 19.6%)	35.2	86.6	47.9	64.4	46.7	55.9	79.9	68.0	85.7	60.0	5-12
Cluster 4 (N_4 = 932, 33.0%)	22.1	100.0	26.4	23.7	14.6	12.2	34.2	32.9	45.7	14.8	1-8

* For Task 7, the number of learners who scored 3 or 4 points for the task is indicated (%).

in cluster 4 the number of such learners was much smaller – 45.8%. The number of points scored by learners for 10 tasks in both clusters lies in the range between 1 and 8.

Socio-demographic differences among Latvian school learners by their achievement in doing mathematical sums

By means of the hi-quadrangle criterion, there were statistically significant differences ($p < 0.01$) among the four clusters of learners over the regions: in cluster 3, the ratio of learners from Kurzeme and Vidzeme was much smaller, and that of learners from Riga and the Riga region was bigger. There were also differences according to the place of residence: in cluster 3, the majority of learners lived in bigger towns (55.2%), and in other clusters the majority of learners lived in the countryside and small towns. An especially big was the ratio of learners from the countryside and small towns in cluster 2 (62%).

No statistically significant differences among the four clusters of learners according to the program of education and sex were found, although it must be noted that in cluster 3 the number of boys was biggest (51.5%).

These results match those of the prior research on learners' achievements in mathematics in Latvia. For instance, in the OECD 2003 study it was stated that school learners from Latvia living in Riga had the highest achievements as compared to learners from other regions of Latvia. The highest achievement was also registered for learners from Riga and bigger towns as compared with learners from the countryside and small towns. Achievements of girls and boys in mathematics were very similar (Geske, Grīnfelds, Kangro & Kiseļova, 2004).

Conclusions

According to the analysis of learners' academic achievements in the Singapore study, Latvian school learners' achievements in mathematics have not improved since 2003. For instance, in 2003, sum 12 was done by 32% of all Latvian learners who participated in the PISA research, but the same sum in 2010 was done correctly only by 23% of learners; 21% of Latvian school learners in 2003 did sum 2 correctly, but in 2010 it was done only by 17% of learners. Of course, there are statistically significant differences among the samplings that took part in the studies in 2003 and 2010, but there are negative trends apparent in the dynamics of Latvian school learners' achievements in mathematics (Geske et al., 2004).

The fact that Latvian school learners' achievements have not improved since 2003 is testified also by a comparison of Latvian learners' achievements with those of other countries in the Singapore study in 2010. Again it must be noted that, according to these results, Latvian school learners scored the lowest place among all participants from Asia and Europe. This result matches that of the PISA 2009 study, except for the fact that in 2009 achievements of Serbian school learners were lower than those of Latvian learners (OECD, 2010).

The number of learners who have shown low results in the Singapore project test in mathematics (34% having levels 0 and 1) greatly exceeds the number of learners who have shown high achievements in this test (4.4% having levels 5 and 6). It must also be noted that in this research none of Latvian school learners scored the maximum number of points; this, in turn, matches the trend revealed in the PISA 2009 indicating a decreasing number of outstanding learners in Latvia. For Latvia, it is an important problem (Geske et al., 2010).

The Latvian school learners surveyed within the Singapore project have not mastered some topics from education standards in mathematics: The level of doing sums was low even for competence 1 level sums. This may be accounted for by the fact that many teachers teach the topics recently added to the standard (e.g., combinatorics) only at the end of grade 9. It is possible that if this study had been performed at the end and not in the middle of the academic year, the learners' achievements in it would have been much better.

Thus, it may be stated that there is a high probability that PISA 2012 learners' achievements in mathematics will not improve and, like in the PISA 2009, will remain lower than the average level of the OECD countries. Latvian education politicians consider the PISA 2009 results to bring out a serious need to analyze the basic education standard in Latvia and the methods of learning. However, this problem may be regarded also from another aspect. For instance, the Norwegian parliament report (Norwegian Parliament, 2009) describes *the teacher* as the most important single factor influencing students' learning. In a review of research on teacher competence, the importance of *teachers' informal competence* is underlined (Nordenbo, Larsen, Tiftikci, Wendt & Ostergaard, 2008). In turn, according to many studies, the process of raising teachers' competence is closely related not only to acquiring knowledge, but also to the formation of teachers beliefs (Shulman, 1987; Ball et al., 2008). Among various predictors that may predict learners' achievements in mathematics, the impact of teachers beliefs on learners' achievements has been little studied so far. Clarifying this correlation between teachers' beliefs and learners' achievements may become a goal of the further research.

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This work has been supported by the European Social Fund within the project,
"Support for the implementation of doctoral studies at Daugavpils University"
Agreement No. 2009/0140/1DP/1.1.2.1.2/09/IPIA/VIAA/015

REFERENCES

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: what makes it special? *Journal of Teacher Education*, No 59, p. 389–407.

Broks A., Geske A., Grīnfelds A., Kangro A. & Valbis J. (1998). Izglītības indikatoru sistēmas [Systems of Education Indicators]. In Grīnfelds A. & Kangro A. (Eds.) *Monogrāfiju sērija. : Izglītības* *pētniecība Latvijā.* [Series of monographs: Study of Education in Latvia] Mon. Nr.2. Riga: Mācību grāmata.

Geske A., Grīnfelds A., Kangro A. & Kiseļova R. (2004). *Mācīšanās nākotnei. Latvijas OECD valstu Starptautiskajā skolēnu novērtēšanas programmā 1998–2004.* [Learning for the Future. Latvia in the OECD International learners' evaluation programme 1998–2004] R.: Latvijas Universitāte.

Geske A., Grīnfelds A., Kangro A. & Kiseļova R. (2007). *Kompetence dabaszinātnēs, matemātikā un lasīšanā – ieguldījums nākotnei. Latvija OECD valstu Starptautiskajā skolēnu novērtēšanas programmā 2006.* [Competence in Science, Mathematics, and Reading – Investment in Future. Latvia in the OECD International learners' evaluation programme 2006] Rīga: SIA „Drukātava".

Geske A., Grīnfelds A., Kangro A. & Kiseļova R. (2010). Ko skolēni zina un prot – kompetence lasīšanā, matemātikā un dabaszinātnēs. Latvija OECD valstu Starptautiskajā skolēnu novērtēšanas programmā 2009. [What learners know and can Do – competence in reading, mathematics, and science. Latvia in the OECD international learners' evaluation programme 2009] Rīga.: Latvijas Universitāte.

Kangro, A. & Geske, A. (2001). Zināšanas un prasmes dzīvei. Latvija OECD valstu Starptautiskajā skolēnu novērtēšanas programmā 1998–2001. [Knowledge and skills for life. Latvia in the OECD international learners' evaluation programme 1998–2001]. Rīga: Mācību grāmata.

Kiseļova, R. (2011). *Latvijas pamatizglītības kvalitātes starptautiska novērtēšanas rezultāti un analīze kā informatīva bāze izglītības vadības lēmumu pieņemšanai. Promocijas darba kopsavilkums.* [Results and analysis of the international assesment of the quality of basic education of Latvia making education management decisions. Summary of the dissertation]. Retrieved 01.08.2012 from http://www.lu.lv/fileadmin/user_upload/lu_portal/zinas/Promocijas%20darba%20kopsavilkums%20Rita%20Kiselova.pdf

Latvian National Standards (2006). *Noteikumi par valsts standartu pamatizglītībā un pamatizglītības mācību priekšmetu standartiem.* [Regulations on National Standard in Basic Education and Basic Education Standards of Academic Subjects]. Retrieved from http://www.likumi.lv/doc.php?id=150407

Morony, S., Kleitman, S. & Stankov, L. (2012). Self-efficacy, anexiety, self-concept and confidence as predictors of achievements in Confucian and European countries. Retrieved 01. 08. 2012 from http://linguistics.byu.edu/faculty/henrichsenl/apa/APA14.html

Nordenbo, S. R., Larsen, M. S., Tiftikci, N., Wendt, R. E., & Østergaard, S. (2008). Lærerkompetance og elevers læring i barnehage og skole. Et systematisk review utført for kunnskapsdepartementet, Oslo. [Teachers' competence and students' learning in kindergarten and school. A systematic review for the Ministry of Education, Oslo]. Dansk Clearinghouse for uddannelsesforskning. København: Danmarks Pædagogiske Universitetsforlag.

OECD (2004). *Learning for Tomorrow's World – First Results from PISA 2003.* Paris: OECD Publishing.

OECD (2010). *PISA 2009 at a Glance*. Paris: OECD Publishing.

Shulman, L. S. (1987). Knowledge and teaching: foundation of the new reform. *Harvard Educational Review*, No 57, p. 1–22.

Norwegian Parliament (2009). Stortingsmelding nr. 11. (2008–2009) [Report No. 11]. *Læreren Rollen og utdanningen [Teacher's Role and Training].* Retrieved 24.08. 2012 from http://www.regjeringen.no/pages/2150711/PDFS/STM200820090011000DDDPDFS.pdf .

MATEMATIKOS PASIEKIMŲ AUGIMO DINAMIKA: TARTAUTINIO TYRIMO ANALIZĖ

Alesja Šapkova

S a n t r a u k a

Straipsnyje iškeliama ypatinga matematikos vieta kiekvienos šalies švietimo sistemoje, nes šiandienėje visuomenėje jaunų žmonių galimybės ir sėkmė dažnai priklauso nuo įgytų matematikos žinių ir įgūdžių. Todėl aktualu nuolat domėtis mokinių matematikos pasiekimais, atskleidžiančiais tikrąjį matematinio švietimo lygį. Tam gali daug padėti tarptautiniai lyginamieji tyrimai, teikiantys informacijos apie matematinio švietimo lygį konkrečioje šalyje ir leidžiantys jį palyginti su kitų šalių pasiekimais.

Šiame straipsnyje siekiama pristatyti 2 828 devintos klasės mokinių, besimokančių Latvijos mokyklose, matematikos pasiekimus. Apie tirtų mokinių matematikos pasiekimus buvo sprendžiama iš atliktų

12 matematikos užduočių dalyvaujant tarptautiniame projekte „Nekognityviniai įgūdžiai ir Singapūro mokiniai – tarptautinis palyginimas“, kurį organizavo Singapūro nacionalinio švietimo institutas. Šio tyrimo rezultatai bus palyginti su 2003 m. tarptautinio penkiolikmečių tyrimo 2003 (PISA) mokinių įvertinimų rezultatais. Tai savo ruožtu leis prognozuoti PISA 2012 m. matematikos ugdymo rezultatus ir įvertinti naujojo standarto matematikos švietimo efektyvumą Latvijoje. Šiame straipsnyje taip pat apžvelgiamos žemo matematinio mokinių išsilavinimo priežastys.

Pagrindiniai žodžiai: mokinių pasiekimai, matematinis ugdymas, tarptautiniai lyginamieji tyrimai.

Įteikta 2013 01 30
Priimta 2013 06 15