

Measuring Hungarian and Slovakian Students' IT Skills and Programming Knowledge

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Abstract: An analysis of Information Technology knowledge of Hungarian and Slovakian students was made using a web based Informatics Test. After the evaluation of the test results, there were found some significant differences in IT skills and programming knowledge of the students from different countries, but these differences do not depend on a different way of teaching. In the following statistical analysis Levene's test, T-test and Z-test was used. The monitoring was held on the $p=5\%$ significance level throughout the analysis. The underlying causes are discussed. Survey results are traced back to differences in the educational systems of the two countries.

Keywords: comparative analysis; measuring; knowledge level; IT skills; programming; Hungary; Slovakia

1 Introduction

The aim of this research is to analyze the efficiency of different teaching methods in Information Technology education in Slovakia and Hungary. Some research was done comparing the school systems [1] and the role of Information and Communication Technology in the education of some European countries [2] [3] [4] [5] [6]. The goal of this research is an analysis of the IT skills and programming knowledge of students from different countries.

The National Basic Curriculum of Hungary describes to teachers the learning material grade by grade and subject.

The National Educational Program of Slovakia does not assign precisely what teachers must teach in the various grades but announces the standards to be reached at the end of the senior section; the aim is to reach preset school leaving standards.

The Education System [7] and the Information Technology education in Slovakia bears a close resemblance to that of Hungary from the point of view how various topics are discussed [8]. Theoretical knowledge, word processing, spreadsheet calculation, database management and programming are parts of the curriculum in both countries.

The topics are the same, but the way they are taught is different. This research analyses whether differences in the IT skills of students depends on the methods with which they are taught or not.

In order to compare students' IT knowledge in different countries, a detailed analysis was needed: checking the various curricula of different grades, the number of weekly Informatics classes and whether Information Technology was compulsory or only an optional subject. Still, it was not enough to carry out the examination.

It was also necessary to check the students' knowledge in various grades in both countries. To make comparisons, a uniform questionnaire was built with questions on different subject matters of Information Technology. Only after sending the questionnaire to the students of both countries could the survey be carried out on the basis of their answers.

In Table I the number of weekly Informatics classes are shown in different grades of the respective countries. Note that Informatics is a selectable course only in the last two years of secondary school in Hungary.

Table I
Number of Information Technology classes in the different grades

Country	1	2	3	4	5	6	7	8	9	10	11	12
Hungary	0,5	0,5	0,5	0,5	2	2	2	2	2	2	3*	3*
Slovakia	0	1	1	1	0,5	0,5	0,5	0,5	0,5	0,5*	0,5*	0,5*

* selectable

Before making any comparison, the first starting hypothesis was that Hungarian students have better IT skills than their Slovakian peers because more Informatics classes are from the 5th grade in Hungary

The second hypothesis was that Hungarian students choosing Information Technology as an optional subject have better programming skills than their Slovakian peers, because the accent is on programming in this level in Hungary.

2 Information Technology Teaching in Hungary

IT education is based on a national curriculum in Hungary [9]. According to the National Basic Curriculum (NBC) of Hungary, the use of IT is to be demonstrated in the first four school grades since 2003 (e.g. search on the Internet, painting with computers, etc.) and is taught in 1 class weekly. According to the Information Technology curriculum, the following subjects are taught from the 5th grade to the 12th grade at the schools of Hungary in 2 classes weekly:

- Word processing
- Spreadsheet calculation
- Presentation
- Algorithm and programming
- Database management

Generally the Microsoft Office suite is taught, and it can be seen that teaching Word processing takes 4 years in Hungary (Table II). Basic algorithms, or rather programming, appears in Information Technology sooner, but recursion, list and tree data structures are only an elective part of the curriculum. Database management begins in the 9th grade. In grades 11-12, CS is just optional. At basic level it is taught 2 hours weekly, on a higher level 3 hours weekly, and a final exam can be taken.

Table II
The subjects of IT by grades in Hungary

Subject	Grade								
	5	6	7	8	9	10	11	12	
Word processing		✓	✓	✓	✓				
Spreadsheet calculation				✓	✓				
Presentation						✓			
Algorithm and programming			✓	✓	✓				
Database management					✓				

3 Teaching Information Technology in Slovakia

The subject Informatics has been compulsory from the 2nd grade since the school year of 2008/2009 (at the time of the introduction of school reform), but it also appears in the 1st grade, as well as in the nursery school curriculum, though not as a compulsory subject. One Informatics class weekly is compulsory in the junior section and 1/2 class weekly in the senior section, which can be raised by the schools' own program. Some schools took the opportunity and increased it to 1 class weekly. The National Educational Program does not assign precisely what teachers must teach in the various grades but announces the standards to be reached at the end of the senior section. So it does not matter if programming is taught in the 6th grade in one school while in the 8th grade in another; the aim is to reach the school leaving standards. It is part of the own educational program of each school how students should reach these standards, how many classes they should have weekly and at what pace they learn the material; this program is accepted by the management and the teachers of the school together.

The National Educational Program divides Informatics into 5 topics (not specifying the number of classes):

- 1 Information around us
- 2 Communication by the means of the ICT
- 3 Problem solving, thinking with the help of algorithms
- 4 Basic principles of the operation of ICT tools
- 5 IS society

These 5 topics are then to be fitted into the school leaving standards.

4 The Method of the Comparison

It is possible to compare the Hungarian and Slovakian Information Technology education via examining the students' knowledge. Since it is quite difficult to send out questionnaires physically to the various schools, and the order of the questions cannot be changed in that case, and also because students sitting close to each other in the classroom can see the other's answers, the most effective solution seemed to be a web-based Informatics test.

Some research was done towards developing the test in order to standardize the IT education in Switzerland [10] and Austria [11].

Questions of varying difficulty were formed on the main topics of Information Technology in this research. The topics chosen were part of Informatics education in almost every country: theoretical knowledge, word processing, spreadsheet calculation, database management and programming. There can be significant deviations in the curricula of some countries; therefore the test was expanded with questions on cryptographical knowledge as well as formal languages and automata since in certain German provinces these are also part of the Information Technology curriculum [12].

The database structure for the test had to be planned in a suitable way so that the data could be obtained later on. The personal data of the students filling in the test were put in a separate table as well, as were their answers to the questions. When filling in the test, the students first had to give their actual grade and some other data. If students gave the username of their teacher then the teacher also could see how they succeeded and would get a feedback on their progress. *Grade* was important because the student would get a question sheet depending on the grade given. Students could mark topics not taught to them (except basic information technology and office packages). If they marked one, the system would not ask questions dealing with the topic but saved it with the answer "I have never learned that". With this option students got fewer questions, and answers would flow in at a quicker pace. Next, students could begin to fill in the test.

Every test question has 6 possible answers, only one of which is correct, 3 of which are bad; the 5th choice is: “I have never learned that”, and the 6th: “I have forgotten it”. The answers “I have never learned that” and “I have forgotten it” show which part of the curriculum the students have not learned in that grade and if they could remember it or not. Every question has two time limits given in seconds. The first is the minimum time to read, understand and answer the question; the second is the maximum answering time. The software saves the total time used by the student. These time limits are not seen or known by the students. These are used during the evaluation, so a correct answer is accepted only if it arrived in the available time interval. Teachers can register on this site too if they are willing to give some of their data. The system is protected by registration code, and registered teachers can log in with their username and password. If a student filling in the test also gives the username of the teacher, then the teacher can later see his/her answers and the results. Some reports can be generated, helping the work of the teacher. The test records whether the students have given the teacher the right to inspect. It also indicates if they have marked a question as not learned or if the topic of the question is familiar to them but they have forgotten the right answer.

The evaluation of the answers is only possible after processing the saved data. The first step is to check whether the students of the given country have learned the given topic. If they have not, the comparison with the data of the students of other countries is impossible to make.

If the students knew the topic because they had learned it, it had to be checked if the time spent answering the questions was within the limits given. If so, the answer could be accepted as right.

The mean and the standard deviation of the right answers had to be calculated in the various grades and countries and comparisons made with the help of statistical means. In order to be able to do this, enough students filling in the test were needed in each grade. When comparing the IT skills of students in two countries, the Independent Samples T-test was taken.

5 Number of Participants

Students filled in the web-test from the 5th grade in Hungary and in Slovakia but so few of the Slovakian students did that in the 6th and 7th grades that the comparison could not be made with them. It was possible only in the 5th and the 8th grades, as well as in the first three years of the secondary school, since the number of Slovakian students in the 12th grade was low (Table III).

Table III
Number of participants

Grade	Hungarian		Slovakian
	Basic education	Informatics course	Basic education
5	79	0	126
6	14	0	114
7	18	0	108
8	169	0	50
9	552	0	111
10	302	0	97
11	104	69	102
12	212	91	21

6 Survey Results

The web-test on Informatics was filled in by altogether 729 students from 22 Slovak cities. After the examination of the number of filled in tests, it looked possible to compare the Informatics knowledge of the Hungarian and Slovakian students in the 5th and 8th grades and in the first 3 grades of secondary school.

Let us look first at the results of students learning basic Informatics (Table IV).

6.1 Result by Subjects

The following table shows the results by countries and subject (Tables IV and V). The mean shows how many questions the students could answer, the next column shows the ratio in percentage and the following one shows the standard deviations.

Table IV

The mean and the standard deviation of the right answers of the Hungarian and the Slovakian students

Grade	Subject	Nationality of students	Mean	percent of correct answers	Std. Deviation
5	Theoretical knowledge	Hungarian	3,04	75,95%	1,16
		Slovakian	1,91	47,67%	1,29
5	Word processing	Hungarian	2,46	49,11%	1,49
		Slovakian	1,21	24,19%	1,08
5	Spreadsheet calculation	Hungarian	0,95	47,47%	0,81
		Slovakian	0,40	19,77%	0,49
8	Theoretical knowledge	Hungarian	9,20	19,99%	4,94
		Slovakian	7,53	16,37%	5,61

8	Word processing	Hungarian	4,33	30,90%	2,15
		Slovakian	3,41	24,37%	1,87
8	Spreadsheet calculation	Hungarian	2,54	13,36%	2,11
		Slovakian	1,76	9,29%	2,02

Table V

The mean and the standard deviation of the right answers of the Hungarian and the Slovakian grammar school students

Grade	Subject	Nationality of students	Mean	percent of the correct answers	Std. Deviation
9	Theoretical knowledge	Hungarian	10,87	23,63%	6,16
		Slovakian	8,61	18,71%	6,44
9	Word processing	Hungarian	5,46	38,99%	2,66
		Slovakian	3,11	22,18%	3,64
9	Spreadsheet calculation	Hungarian	2,18	11,50%	1,94
		Slovakian	2,84	14,96%	2,85
9	Database management	Hungarian	0,63	3,47%	1,68
		Slovakian	0,16	0,88%	0,72
9	SQL	Hungarian	0,02	0,25%	0,32
		Slovakian	0,05	0,66%	0,32
9	Programming	Hungarian	0,00	0,00%	0,00
		Slovakian	1,42	5,68%	2,92
10	Theoretical knowledge	Hungarian	10,61	23,07%	6,25
		Slovakian	9,39	20,42%	5,22
10	Word processing	Hungarian	4,96	35,43%	2,76
		Slovakian	3,67	26,19%	2,53
10	Spreadsheet calculation	Hungarian	2,63	13,82%	1,94
		Slovakian	2,58	13,56%	2,31
10	Database management	Hungarian	1,20	6,68%	2,24
		Slovakian	0,18	1,01%	1,04
10	SQL	Hungarian	0,06	0,79%	0,51
		Slovakian	0,00	0,00%	0,00
10	Programming	Hungarian	0,00	0,00%	0,00
		Slovakian	2,12	8,16%	3,79
11	Theoretical knowledge	Hungarian	11,82	25,69%	6,31
		Slovakian	11,23	24,41%	4,68
11	Word processing	Hungarian	5,88	41,96%	2,88
		Slovakian	3,43	24,49%	2,15
11	Spreadsheet calculation	Hungarian	3,27	17,21%	1,88
		Slovakian	4,17	21,95%	2,32
11	Database management	Hungarian	3,17	17,63%	2,73
		Slovakian	1,14	6,35%	2,33

11	SQL	Hungarian	0,21	2,64%	1,36
		Slovakian	0,00	0,00%	0,00
11	Programming	Hungarian	0,00	0,00%	0,00
		Slovakian	4,69	18,02%	3,88

The data in the table show that Hungarian students in the 5th grade performed better since they gave the right answers for more questions. This seems to change in the 8th grade. The topic of database management is not included in the table because no students in this grade learned it in either country.

The Hungarians seemed to be better at word processing in the 9th and 10th grades. Hungarian students do not learn database management until they start their secondary education, though according to the curriculum they should already in the 8th grade. This topic is taught in the secondary school, but in the 9th grade only 10%, in the 10th grade only one third, and in the 11th grade two thirds of the students told so; and most of the good answers (17.6%) were also given by them.

Approximately 5% of the Slovakian students learned database management in the 8th grade, 20% of them in the first part of secondary education and half of them in the 11th grade, but they could not give as many right answers as their Hungarian peers, who did not perform outstandingly either.

The topic of SQL is not discussed in either of the countries, though it should be a significant part of database management. Hungarian students start learning database management in the 10th grade, but few gave correct answers to the 18 questions.

Apparently Slovakian students get to know the topic of programming in the 9th grade and go on with it in the 10th grade, but only a few proper answers were given to the questions. Their Hungarian peers do not learn programming at all despite the regulations of the National Core Curriculum that makes it compulsory from the 7th grade. Hungarian students achieved better results in word processing throughout the test and gave proper answers to approximately half of the questions, while Slovaks knew the right answer only in a quarter of the questions. Hungarian students do not learn programming at all, only if they choose Informatics as an optional subject in the second half of the secondary school years. The National Core Curriculum assigns programming to students from the 7th grade in vain. In Slovakia, one third of the students in the 8th grade have already learned programming, and at least half of them have met the topic of algorithmical thinking by the end of their secondary school years. Their accomplishment is not outstanding in the first half of their secondary school education since they knew the correct answer to only 8% of the questions, but a significant improvement can be observed in the 11th grade. Here they scored 18%.

In many cases it is not enough to examine the results in percentage in order to compare the students' achievements. It can only be stated unambiguously after the statistical analysis regarding in which grades and in which topics are significant differences between the students from different countries.

6.2 Analysis of the Means by Subjects

The next step in the analysis was to inspect whether the means by subject would differ if using the Independent samples test. The null hypothesis was that no significant difference would exist between the means of all subjects by countries. Because of having two independent samples, it was possible to use the T-test to decide whether the hypothesis was true or not (Table VI). If the analysis of the results (*Levene test*) showed the variance of the two groups different ($p < 0.05$) [13], in this case the means could be compared with *Welch's t test* ($p < 0.05$) [14] otherwise, the means could be compared with *T-test* ($p < 0.05$) [15].

Table VI
Independent sample test of the Hungarian and the Slovakian students

Grade	Subject	Levene's test for Equality of variances		T-test for equality of means		means are different
		F	Sig.	t	Sig. (2-tailed)	
5	Theoretical knowledge	1,52	0,22	4,95	0,00	yes
5	Word processing	7,39	0,01	5,30	0,00	yes
5	Spreadsheet calculation	0,03	0,86	3,15	0,00	yes
8	Theoretical knowledge	0,30	0,58	1,31	0,19	no
8	Word processing	0,52	0,47	1,69	0,09	no
8	Spreadsheet calculation	2,49	0,12	2,21	0,03	yes
9	Theoretical knowledge	1,95	0,16	2,18	0,03	yes
9	Word processing	3,19	0,07	5,13	0,00	yes
9	Spreadsheet calculation	1,10	0,30	0,10	0,92	no
9	Database management	11,70	0,00	3,42	0,00	yes
9	SQL	1,44	0,23	-0,62	0,54	no
9	Programming	645,44	0,00	-3,00	0,00	yes
10	Theoretical knowledge	0,02	0,90	1,08	0,28	no
10	Word processing	0,03	0,86	2,58	0,01	yes
10	Spreadsheet calculation	0,10	0,75	1,40	0,17	no
10	Database management	26,87	0,00	4,58	0,00	yes
10	SQL	410,24	0,00	2,12	0,03	yes
10	Programming	2,02	0,16	-9,85	0,00	yes

11	Theoretical knowledge	1,42	0,24	0,51	0,61	no
11	Word processing	4,15	0,04	4,61	0,00	yes
11	Spreadsheet calculation	1,45	0,23	-0,58	-0,33	no
11	Database management	1,53	0,22	3,94	0,00	yes
11	SQL	3,34	0,07	0,92	0,36	no
11	Programming	340,64	0,00	-12,41	0,00	yes

The table above contains the results of the Independent Samples T-test, and in the last column it can be seen if there are any significant differences between the knowledge of the Hungarian and the Slovakian students in the respective grades concerning the given topics. On the basis of this, it could be confirmed that Hungarian students in the 5th grade were better in all of the three topics. In the 8th grade they achieved better results only in spreadsheet calculation. In the 9th grade they scored higher marks than their Slovakian peers in both theoretical knowledge and word processing. The differences in database management show that Slovakian students had not learned the subject yet, while in programming it is the other way around; the lack of knowledge of the Hungarian students causes the differences. In the 10th grade the Hungarians achieved better results in word processing; they had already learned database management while their Slovak peers had not learned it yet. The Hungarians had not really learned SQL and this makes a difference. Slovakian students go on learning programming while Hungarian students have to give it up in the basic Informatics training. The 11th grade was the last one under examination. The Hungarians were far better at word processing than their Slovakian peers; more and more of them have learned database management while in Slovakia this topic has been left out of the education. The Hungarians did not learn programming in this grade either while the Slovakian students developed their knowledge in this field.

7 Comparing the Knowledge of Informatics of Regular Slovakian Students with those of Hungarians Specialized in Informatics

In the previous section it was seen that Hungarian students did not learn programming in the basic Informatics classes; they just started to learn database management and did not really get involved in it, and instead, their teachers taught them word processing and spreadsheet calculation. Now let us see the scores of the students who have chosen Informatics as an optional subject and who still learned Informatics in the last two years of secondary school. Since the Slovakian students in the 11th grade were the ones who filled in the test in an adequate number, we can only take this grade into consideration.

7.1 Result by Subjects

The following table shows the results of the proper answers of the Slovakian students and Hungarian students having chosen Informatics as an optional subject in the 11th grade on the basis of topics (Table VI).

Table VII

The mean and the standard deviation of the right answers of the Hungarian students having chosen Informatics as an optional subject and Slovaks in the 11th grade

Grade	Subject	Nationality of students	Mean	percent of the correct answers	Std. Deviation
11	Theoretical knowledge	Hungarian	13,43	29,21%	7,61
		Slovakian	11,23	24,41%	4,68
11	Word processing	Hungarian	5,48	39,13%	3,30
		Slovakian	3,43	24,49%	2,15
11	Spreadsheet calculation	Hungarian	3,16	16,63%	1,88
		Slovakian	4,17	21,95%	2,32
11	Database management	Hungarian	3,09	17,15%	2,29
		Slovakian	1,14	6,35%	2,33
11	SQL	Hungarian	0,45	5,62%	1,55
		Slovakian	0,00	0,00%	0,00
11	Programming	Hungarian	7,09	27,26%	4,67
		Slovakian	4,69	18,02%	3,88

Looking at table VII you see that Hungarian students specialized in Informatics have better skills in database management and programming taught in the 11th grade than Slovakian students, while Slovakian students achieve better results in spreadsheet calculation. But the results given in percentage are not enough; to examine the difference in skills of students from different countries a deeper analysis is needed (Levete's test, T-test).

7.2 Analysis of the Means by Subjects

The following table shows the results of the Independent Samples T-test of the Slovakian students and Hungarian students specialized in Informatics in the 11th grade on the basis of topics (Table VIII)

This table shows that the statements made on the basis of the previous percentile values are confirmed; the differences are also verified by the statistical examination.

Table VIII

Independent sample test of the Slovakian students and Hungarian students specialized in Informatics in the 11th grade

Grade	Subject	Levene's test for Equality of variances		T-test for equality of means		means are different
		F	Sig.	t	Sig. (2-tailed)	
11	Theoretical knowledge	3,61	0,06	1,57	0,12	no
11	Word processing	6,66	0,01	3,33	0,00	yes
11	Spreadsheet calculation	0,00	0,95	-2,12	0,04	yes
11	Database management	4,18	0,04	3,66	0,00	yes
11	SQL	12,50	0,00	1,71	0,02	yes
11	Programming	0,44	0,51	2,62	0,01	yes

Hungarian students specialized in Informatics do better in the 11th grade in database management than the Slovakian students, as students getting only basic education. This is not surprising since these students have gained very similar basic knowledge in the first half of secondary education.

The Slovakian students achieve better results in spreadsheet calculation as we have also seen in the case of students learning basic Informatics. SQL is still a neglected area; Hungarian students can hardly give any correct answers, but since Slovakian students do not learn it at all, the difference between the two countries can easily be detected.

It is in the field of programming that we can see the advantages of being on an Informatics course compared to getting a basic Informatics education. Here teachers obviously have the time to help the students know this area. That is why the Hungarian students have scored higher points than their Slovakian peers.

8 Comparing Programming Knowledge of Regular Slovakian Students with that of Hungarian Students Specialized in Informatics

Hungarian students do not learn programming in a basic Informatics course [16, 17]. This means only scores of those students can be analyzed who have chosen Informatics as an optional subject and learn Informatics in the last two years of secondary school [18]. Since Slovakian students in the 11th grade were the ones who filled in the test in adequate numbers, only this grade could be considered in the following analysis.

8.1 Differences by Nationality in Programming

It seems clear from this survey that the results of the independent sample test of regular Slovakian students as well as their Hungarian counterparts specialized in Informatics in the 11th grade show different means of programming marks (Table VIII). Hungarian students scored more correct answers (~27%) than their Slovakian peers (~18%) (Table VII). A deeper analysis of the different programming topics was needed to make a decision about the second hypothesis, as it was in the case when knowledge by genders was discussed in Hungarian grammar schools [19] and higher education [20].

The following table is a break-down by programming topics showing what percent of students in this grade answered correctly the questions put to them (Table IX).

In order to know whether the means by Programming topic are equal, a Z-test [21] was accomplished.

The null hypothesis of Z-test was that no significant difference existed between the means by nationality. The monitoring was held on the $p=5\%$ significance level. The critical value of Z-test was between -1.96 and 1.96 at $p=5\%$ significance level. If the calculated value of Z-test was in this range, the null hypothesis could be kept. The table shows the calculated values of the Z-test by nationality and the decision on keeping the null hypothesis or not.

Table IX

How many percent of students answered successfully the questions - grouping by nationality

Programming topic	Hungarian		Slovakian		Value of Z-test	Decision
	%	Std. dev.	%	Std. dev.		
Flowchart	35,2%	0,48	28,6%	0,46	-2,74	The means are not equal
Structogram	22,0%	0,42	11,4%	0,32	-1,42	The means are equal
FOR cycle	43,4%	0,50	27,1%	0,45	-2,67	The means are not equal
Repeat-Until cycle	19,2%	0,40	14,3%	0,35	-1,78	The means are equal
Do-While cycle	26,4%	0,44	12,9%	0,34	-1,49	The means are equal
Parameter passing	16,5%	0,37	15,7%	0,37	-1,97	The means are not equal
Sort algorithm	14,3%	0,37	24,3%	0,43	-2,80	The means are not equal
Array management	9,9%	0,30	17,1%	0,38	-2,25	The means are not equal
Subroutine	42,9%	0,50	23,8%	0,43	-2,24	The means are not equal
Stack management	12,1%	0,33	14,3%	0,36	-1,94	The means are equal
Binary three knowledge	6,0%	0,24	17,1%	0,44	-2,13	The means are not equal

List knowledge	19,2%	0,40	27,5%	0,41	-3,19	The means are not equal
Recursion	15,0%	0,48	8,6%	0,28	-1,09	The means are equal
Binary search algorithm	11,0%	0,31	20,0%	0,41	-2,52	The means are not equal
The Eight Queens Problem	25,0%	0,28	14,3%	0,36	-2,07	The means are not equal

According to the table it could be asserted at $p=5\%$ significance level that Hungarian and Slovakian students were not on the same knowledge level regarding different programming topics in the 11th grade (Table IX).

Hungarian students answered the FOR cycle question more successfully, but no difference could be found in answers dealing with Repeat-Until and Do-While cycles. The questions of the Sort and the binary search algorithm proved easier to answer for Slovakian students in connection with array management. On the other hand, Hungarian students were more experienced in subroutine and backtracking algorithms.

More Slovakian students gave correct answers than Hungarians in the topics related to dynamic memory management (binary trees, lists). It looks like Hungarian and Slovakian students learn the programming part of Information Technology in a different way. Slovakian teachers spend more time on array management, sort, search algorithm and dynamic memory management. The emphasis is on subroutine and backtracking algorithms in Hungary. While Slovakian students acquire a well-founded basic knowledge, Hungarian counterparts rather learn high level programming topics (like backtracking algorithms). My opinion is that a deeper basic knowledge for Hungarian students should have a priority over high level programming topics (which can be taught later anyhow).

Conclusions

The first starting hypothesis according to which the Hungarian students have better IT skills than their Slovakian peers was only partly justified. Topics were found not taught in either of the countries. Examining the efficiency of teaching Informatics in Slovakia and in Hungary it can be said that in the beginning Hungarian students do better concerning theoretical knowledge and they receive a better basic education, but later this advantage disappears. Hungarian students performed better in word processing during the whole test; teachers seem to put the emphasis on this topic in our country. The starting advantage in spreadsheet calculation disappears by the end of the secondary school; Slovak students provided the same results. Hungarian students are more likely to have learned database management than Slovaks but a lot later than assigned in the curriculum and efficiency is not satisfactory. As for programming, it is just the other way around. Slovakian students learn algorithms already in the 8th grade; their Hungarian peers do not meet this topic until they finish secondary school, in

spite of the fact that students should start dealing with it in the 7th grade according to the regulations of the National Core Curriculum. If specialized in Informatics there is enough time to learn it in the second half of secondary school.

The second starting hypothesis was that the Hungarian students specialized in Information Technology would reach higher scores in programming than Slovakian students. This assumption turned out to be correct in the 11th grade. Students choosing this get to know the beauties of programming and produce higher scores than the Slovaks. Hungarian students were more experienced in subroutine and backtracking algorithms, but more Slovakian students gave correct answers in the topics related to dynamic memory management.

Now a conclusion can be made: the IT skills level of students does not depend on the different way of teaching. Teachers in Slovakia have freedom of action as to how to order the topics, but outgoing standards are firmly set by the National Educational Program. On the other hand, teachers in Hungary have to stick strictly to the National Basic Curriculum grade by grade, subject by subject. However one can see what really counts is the time and efforts invested by the teachers.

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