The Influence of the Type of Secondary School and the Weekly Allocation of Informatics on Results of Students' Achievements in Computer Science – Case Study

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Abstract

The level of students coming to the University of Žilina is very different. There are significant differences in the level of knowledge from secondary schools, in the way of study, in the approach to the responsibilities and, last but not least, in the pursuit of new knowledge. Many students have difficulties integrating fully into the study process and are having problems to master the study of the first year. Therefore, research was conducted to find out what is the big difference between students, which is affecting their achievements. The article describes the results of the research done at the Faculty of Operation and Economics of Transport and Communications of the University of Žilina. There were several research objectives. The first goal was to find out the impact of the type of secondary school on the results of the study at the university from the subjects of Informatics in both semesters. The second objective was to find out how the number of hours in the subject of informatics weekly attended at secondary school affects the grade from Informatics at the faculty. The third goal was to compare study results in both semesters. To obtain the results was used the One-Factor Variance Analysis Method, T-Test for Two-Sample Assuming Unequal Variances, t-Test Paired Two Sample for Means.

The research showed that the type of secondary school influences the study results in both semesters.

Another interesting fact was that students who had a lot of informatics in secondary school do not achieve better results than those who have much less of Informatics. The results of the 2nd semester show that some of the students have adapted to the situation, improved their learning outcomes and were able to move further to the next years.

Keywords: Informatics, the One-Factor Variance Analysis Method, T-Test for Two-Sample Assuming Unequal Variances, t-Test Paired Two Sample for Means.

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1. Introduction

Using information technologies (IT) is an indispensable trend in all areas of our life. At this time it is not possible to imagine any activity without up-to-date technologies and using IT has become an essential part of our lives. Working life requires the use of the computer by professionals in all areas. Therefore, it is necessary to include the subject of Informatics in the program for all levels of school education.

Informatics is a relatively new subject compared to mathematics. As a result, there has been much less research done in IT education.

Currently, there is no standard international agreement in OECD countries on the adopted framework for teaching informatics and information technology. Nevertheless, this issue has been discussed many times at different levels. Lack of research in this area makes it challenging to identify methods, forms and contents that are effective in teaching informatics.

The first concept of computer science teaching at schools in Slovakia in the 1970s, 1980s and early 1990s was based on the creation of algorithms and programming under the slogan "Programming, Second Literacy". In the early 1990s, schools were asked to teach students how to work with computers, namely to know the operating systems and the essential applications of word processing and spreadsheets. In the late 1990s, the teaching of the so-called modern computer science was launched. These included five essential topics – information about us, computer systems, algorithms and creating algorithms, areas of use of informatics and information society.

Textbooks and worksheets were created later for specific topics.

The educational content of Informatics for ISCED2 and ISCED3 (eg. [1], [2]) is currently divided into five areas:

- Information Around Us,
- Communication through IT,
- Procedures, Problem Solving, Algorithmic Thinking,
- Principles of IT functioning,
- Information Society.

Subjects at secondary schools are taught according to these areas. There are subjects such as Work with Applications, Office, Operating Systems, Computer-Networking Basics, Programming Basics and others. The level of teaching depends on the type and level of secondary school.

At the Faculty of Operation and Economics of Transport and Communications of the University of Žilina, the subject of Informatics is included in the first year in all study fields of full-time and part-time study. The course aims to develop knowledge of secondary school computer science and to stress out the use of computer capabilities as a tool for the implementation of information technology in profile professional applications. Teaching is oriented to gaining the knowledge that graduates need in their practice. Therefore, they were designed in such a way that graduates have the best chance of successfully passing the entrance tests before getting the job and become successful within their new positions.

The subjects of Informatics 1 and Informatics 2 have a practical and theoretical part. In the practical part of the lesson, some Office applications are practiced, where students will gain practical computer skills and essential knowledge to use any application they may encounter in practice.

The theoretical part of the first semester consists of teaching basic knowledge about personal computers such as personal computer hardware and basic principles of operating systems. In the second semester, the lessons are focused on computer networks, their principles and their functioning.

2. Materials and methods

In recent years were encountered several problems that affect not only the learning results but also the teaching process itself. Moreover, the problems have a negative impact on the professional quality of the lectured subject matter in exercises and lectures.

Teachers often meet with the inability of most students to work systematically throughout the term, which means:

- During the teachers' explanation, they do not concentrate on the subject matter explained as they are not able to focus on learning.

• Tasks in exercises are done only superficially.

• Students do not rely on their abilities and do not like it if the teacher asks them to try to perform the tasks themselves without help.

Another problem is studying for an exam. Many students are not interested in acquiring more profound knowledge. They are not interested in mastering the subject as best as possible. Most of the effort is spent on passing an exam, learning only basics and getting the grade from the exam.

One of the reasons may be narcissism, which is described and its consequences are explained in the article by the author M. Podzimek from 2019 in "Problems of narcissism in education: The culture of narcissism as a dangerous global phenomenon for the future". It is the narcissism observed in young people that can have undesirable effects both concerning studies but also in relation to authorities, i.e., university professors and teachers. It is a consequence of modern times (Podzimek, 2019).

Modernism, which appeared as a result of industrialization, has since then developed further, resulting in a postmodern society, characterized by a significant change in values. This shift in values is particularly evident in the quality of education, and man's subsequent relation towards work as a result. Schools have become social institutions in which learners spend their time in the role of served clients. The teacher is therefore assigned the social role of the servant, in which he is to satisfy the pupil in his personal needs primarily. This kind of relationship stems from the phenomenon of narcissism, which is already a cultural phenomenon (Podzimek, 2019: 489).

Furthermore, it can be one of the problems why students in schools do not have such quality results as they can achieve based on their prerequisites.

Another reason why some students have difficulty in studying at a university may be the Massification of higher education that means, that university also accepts students who should not have studied at all at the university some decades ago, now they can attend universities and also the curriculum is too challenging for them. As mentioned in the article of K. Vančíková however, the massification of higher education is a natural response of society to the new demands of the era and it is logical to assume that by the end of the 21st century the vast majority of the population will have higher education. Slovakia lags behind the OECD and EU average in this indicator. The issue is not how many students head towards higher education but what programs they are heading for. Massification is a problem or challenge for university education worldwide, as evidenced by the authors' work of Deane E. Neubauer, D., E., Ka Ho Mok, Jin Jiang in work "The Sustainability of Higher Education in an Era of Post-Massification. Series: Routledge Critical Studies in Asian Education". The book researches the sustainability of mass university education across the Asia-Pacific region and its consequences, challenges and particular country constraints. Over the last three decades, the massification of university education has been through in complex and in some cases overwhelming ways. Moreover, both universities and secondary schools must adapt their teaching programs to a new trend.

Probably the most significant change in the way of study has been brought by the Internet.

Interaction and Information technologies have reshaped our life today, and nowadays' students and teachers have massive use of smartphones, iPads and other portable devices; moreover, they are continually looking for cutting edge technologies (Alabdulkareem, 2018: 583).

The Internet is a phenomenon we cannot imagine our life and work without. This phenomenon has its pros and cons. Here is described some aspects of its negative influence on university studies.

• Impact of web pages on knowledge.

• The vast amount of information available to everyone and everywhere. It is difficult to determine which information is relevant and can be used as reliable.

• Mobile networks and connectivity to the Internet.

• It allows students to surf the Internet during lessons that distract their attention from gaining knowledge. It allows also cheating on exams to an extent which was never seen in history before.

Mentioned problems are less evident in certain groups of student. Teachers were interested in what may affect the achievement of students at universities.

Students at first filled in questionnaire in which they specified type of secondary school attended, number of Informatics lessons per week, location of secondary school etc. Out of these

information and expertise of university teachers there were main areas of research determined – how the type of secondary school and the number of lessons of informatics weekly affects the results of the subject Informatics at the university. The article describes verifying the following research issues:

• Whether and to what extent can type of secondary school influence sudents' 1st semester study results in the subject Informatics 1.

• The impact of the number of lessons per week in secondary school on the grade from the subjects of Informatics 1.

• Whether and to what extent can type of secondary school influence their 2nd semester study results in the subject Informatics 2.

• The impact of the number of lessons per week in secondary school on the grade from the subject of Informatics 2.

• Grades of both semesters. Whether there is improvement during second term, whether students learned to work more effectively during classes, to look out and study from literature and to prepare for successful passing of the exam.

3. Results
3.1. Data Analysis – the 1st Semester

Verifying following research issues – Whether and to what extent can type of secondary school influence their 1st year study results in the subject Informatics 1.

Secondary schools were divided into three categories according to the type of secondary schools in Slovakia:

Grammar School
Business Academy
Secondary Technical School

To study research issues, there were used the grades of 290 students and average grade from an IT exam was calculated for every type of secondary school. This shows that a type of secondary school affects students' results at university (Table 1).

Table 1. The Average Grade in the Informatics1 Exam according to the Type of School

Grammar School	3,11224
Business Academy	3,69474
Secondary Technical School	3,9596

For statistical evaluation of the results obtained in the experiment, was used one – factor variance analysis (Tirpáková, 2011). It was expected that the level of the mean of three primary complexes depends on one factor – type of secondary school (Table 2).

Therefore the research group was divided into three groups: 98 students from Grammar Schools, of 94 students of Business Academies and the third group was consisted of 98 students from Secondary Technical Schools from all over Slovakia and other European countries. The decision factor in the selection of research subjects was the agreement in the following relevant indicators:

Use of identical teaching materials, agreement in the time-thematic plans and the same lesson allocation for the subject of Informatics.

Verification of each hypothesis proceeded according to separate experimental plan.

Number of observations $N = 290$. The values of the observed X were sorted into three groups with unequal numbers of observations, where $n_1 = 98, n_2 = 94, n_3 = 98$.

To apply statistical method of one – factor dispersion there were analysis three conditions necessary:

Selected samples come from basic complexes with normal division, selected samples are independent and dispersions of basic complexes are equal.

The observed character X denoted the level of students' knowledge reached in the subject Informatics1. Measured values represent the realization of mutually independent and random

selections from the basic complexes, in which the observed sign X has a normal division $N(\mu_1, \sigma_1^2)$, $N(\mu_2, \sigma_2^2)$, $N(\mu_3, \sigma_3^2)$.

μ1 denotes the average level of students' knowledge from Grammar Schools,

μ2 denotes the average level of students' knowledge from Business Academies,

μ3 denotes the average level of students' knowledge from Secondary Technical Schools.

To verify the first condition – the selected samples come from the basic sample with normal division – was used Shenton-Bowman test. The test confirmed the normality of selective complexes.

Second condition – the selected samples are independent, was accomplished in relation to the construction of random variables during our pedagogical experiment.

For the verification of the third condition – the dispersions of basic samples are equal – we used the Von Neumann test for the equality of dispersions.

We denoted n_1, n_2, n_3 the size of the samples and S_1^2, S_2^2, S_3^2 variance of the samples. Let $n_1 + n_2 + n_3 = N$. The testing statistics of the Von Neumann test for testing the null hypothesis H0: The dispersions of basic sample are the same, versus to H1: the dispersions of basic samples are different has the form:

$$L = -\sum_{i=1}^{3} n_i \cdot ln\frac{S_i^2}{S^2}; \quad S^2 = \frac{1}{N}\sum_{i=1}^{3} n_i S_i^2.$$

The verified hypothesis H0 is rejected at the significance level $\alpha = 0,05$, if the value of tested criterion $L \geq \chi_{0,05}^2(2)$. $\chi_{0,05}^2(2) = 5,991$ is the tabulated critical value for $k = 2$. The value of the testing characteristics $L = 1,028$. Hypothesis H0 is not rejected at the significance level $\alpha = 0,05$. The assumption of the equality of dispersions for all three basic samples has been proved.

After the verification of conditions a) – c) we proceeded to the one – factor analysis of variance for unbalanced attempt as the compared samples have normal dispersion and the dispersions of basic samples are equal.

Tested hypothesis: $H_0: \mu_1 = \mu_2 = \mu_3$ versus to the alternative hypothesis H_1 : Not all μ_i are equal providing the dispersion equality $\sigma_1^2, \sigma_2^2, \sigma_2^2$. The calculation was realized in the MS Excel program for the ANOVA function for the significance level $\alpha = 0,05$. The output table of the one-factor analysis of variance consists of two parts; the values of descriptive characteristics of specific factor levels are calculated in the first part (size of the samples, average and dispersion of the samples).

The second part contains total sum of squares (SS), the numbers of degrees of freedom (df), the mean square of variance (MS), the value of testing criteria $F = 9,382641$ and the critical value $F_{crit}(2,287) = 3,027221$.

As $F > 3,0272$ is valid, we reject the H_0 hypothesis at the significance level $\alpha = 0,05$, which means that level of students' knowledge from different schools A, B, C are significantly different.

The same result is obtained by the use of the value $Value\ P$. As the value $P = 0,000113$, the value of error we get if the null hypothesis is rejected is approximately 0,011 %, which is allowable error rate at the significance level $\alpha = 0,05$ (Table 1).

Table 2. Anova Single Factor

Anova: Single Factor						
SUMMARY						
Groups	Count	Sum	Average	Variance		
Column 1	98	305	3,112245	2,203766042		
Column 2	94	346	3,680851	1,875543354		
Column 3	98	388	3,959184	1,750894172		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	36,48622	2	18,24311	9,382641431	0,000113	3,027221
Within Groups	558,0276	287	1,944347			
Total	594,5138	289				

Teachers were also interested in the fact, which two of three are significantly different in their effectiveness, for this problem was used Duncan's test for the statistical significance of contrasts. The average numbers of points were arranged according to their size, $\bar{x}_1 = 3,11; \bar{x}_2 = 3,68; \bar{x}_3 = 3$.

The value of tested criterion was calculated, given S_r^2 as a residual dispersion (1)

$$D_p = \frac{|\bar{x}_i - \bar{x}_j| \cdot \sqrt{2}}{\sqrt{\left(\frac{1}{n_i} + \frac{1}{n_j}\right) \cdot S_r^2}} \; ; \qquad p = 2,3.$$

The relevant tables were used for the determination of critical values of Duncan's test $D_{0,05}$ for the significance level $\alpha = 0,05$ for given p and given residual number of degrees of freedom $290 - 3 = 287$. These data were entered into the Table 3 together with the calculated values $D_{p,\alpha}$.

By means of these characteristics, was tested the statistical significance of the particular arithmetic averages (Šusteková, Kontrová, 2019).

Table 3. The Critical Values of Duncan's Test

p	$D_{p,critic}$	i, j	$D_{p,0,05} = \dfrac{\|\bar{x}_i - \bar{x}_j\| \cdot \sqrt{2}}{\sqrt{\left(\frac{1}{n_i} + \frac{1}{n_j}\right) \cdot S_r^2}}$
2	2,772	i = 1, j = 2	4,24
2	2,772	i = 2, j = 3	2,08
3	2,91	i = 1, j = 3	6,32

The results between the first and second sample: $p = 2, D_{2,\alpha} = 4,24: D_{2,\alpha} > D_{2,critic}$ thus differentia is significant, the results between the second and third sample: $p = 2, D_{2,\alpha} = 2,08; D_{2,\alpha} < D_{2,critic}$ thus differentia is not significant.

Results between the first and third sample: $p = 3, D_{3,\alpha} = 6,32; D_{3,\alpha} > D_{3,critic}$ thus differentia is significant.

Result: There is a significant difference in learning outcomes between Grammar School and Business Academy and Grammar School and Secondary Technical School.

Business Academy and Secondary Technical School do not have a significant difference.

The results show that students from Grammar Schools are best prepared for studies.

Verifying following research issues – Whether students with a higher number of lessons in computer science than two hours weekly (group 1) in a secondary school achieved better results in the Informatics 1 than students whose lesson allocation was equal or less than 2 lessons per week (group 2).

The study results are pointing out that the number of computer science lessons per week at secondary schools does not affect the learning results. It is shown by the average grades of both student groups (Table 4).

Table 4. The Average Grade in the Exam Informatics1 according to the Number of Hours of Computer Science Lessons in a Secondary School per Week

Number of hours per week > 2	3,568627451
Number of hours per week <= 2	3,675675676

Based on the formulation of the experiment's aim the following hypothesis was set:

H_1: The students with more than two lessons of computer science per week at a secondary school achieved better results in the Informatics1 exam than the students whose lesson allocation was less than 2 hours per week.

To verify the hypothesis H_1, was selected a significance level $\alpha = 0{,}05$. There were compared two groups of data: in the first set, there were results from the examination of students with higher allocation.

There were two independent samples n = 36, m = 255. With the sample characteristics by using T – test. It was found out that the difference between their distributions is not statistically significant. For this reason was tested the difference between the two groups by a two-sample location Student's t-test with equal distribution.

There was tested the hypothesis H_0: $\mu_1 = \mu_2$ versus H_1: $\mu_1 \neq \mu_2$

The value of test statistics is T = 0,26018 and p = 0,7949.

After comparing it with the critical values of a t-test were obtained:

$T = 0{,}2601 < t_{0,05}(289) = 1{,}9682$.

The H_0 hypothesis was not rejected. The selective average on the selected significance level does not differ from the value of the average of the basic file (Šusteková, Kontrová, 2019).

Table 5. Results of T-Test Two-Sample Assuming Equal Variances

t-Test: Two-Sample Assuming Equal Variances		
	Variable 1	Variable 2
Mean	3,638888889	3,57254902
Variance	2,408730159	2,001605682
Observations	36	255
Pooled Variance	2,050911414	
Hypothesized Mean Difference	0	
df	289	
t Stat	0,260181256	
P(T<=t) One-Tail	0,397454616	
t Critical One-Tail	1,650143229	
P(T<=t) Two-Tail	0,794909233	
t Critical Two-Tail	1,968206436	

The results of the statistical analyses did not confirm our expectations. There were obtained the following results: Students with a higher number of lessons in computer science than two lessons (group1) a week at a secondary school do not achieve better results in the Informatics 1 exam than students whose lesson allocation was equal or less than 2 hours a week (group 2).

3.2. Data Analysis – the 2nd Semester

In the second semester, research was conducted on a sample of 182 students participating in the exam. These are the same students as in the first semester, but the number is lower because some students have dropped out early and some have failed the exam.

Verifying following research issues – Whether and to what extent can type of secondary school influence their 1st year study results in the subject Informatics 2.

Table 6 shows that the order of success of students according to secondary schools is the same as in the first semester, i.e., the best is Grammar School, then Business Academy and then Secondary Technical School.

Table 6. The Average Grade in the Informatics2 Exam according to the Type of School

Grammar School	2,38
Business Academy	2,778
Secondary Technical School	2,932

For statistical evaluation of the results obtained in the experiment, was used one – factor variance (Tirpáková, 2011). It was expected that the level of the mean of three basic complexes depends on one factor – the type of secondary school (Table 7).

Table 7. Anova Single Factor

Anova: Single Factor						
SUMMARY						
Groups	Count	Sum	Average	Variance		
5	85	203	2,388235	1,454622		
4	17	48	2,773529	1,404412		
5	88	258	2,931818	1,604493		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	13,16606	2	6,583028	4,330791	0,014502	3,04424
Within Groups	284,2497	187	1,520052			
Total	297,4158	189				

Because the F > 3,0272 is valid, the H_0 hypothesis was reject at the significance level $\alpha = 0,05$, which means that the level of students' knowledge from different schools A, B and C are significantly different.

The same result is obtained by the use of value Value P. As the value P = 0,014502, the value of error was get if the null hypothesis is rejected and it is approximately 1,45 %, which is allowable error rate at the significance level $\alpha = 0,05$.

Duncan's test was used for the statistical significance of contrasts again. The average numbers of points were arranged according to their size.
$$\bar{x}_1 = 2,38; \qquad \bar{x}_2 = 2,77; \qquad \bar{x}_3 = 2,93.$$
The value of tested criterion was calculated, given S_r^2 as a residual dispersion (2).
$$D_p = \frac{|\bar{x}_i - \bar{x}_j| \cdot \sqrt{2}}{\sqrt{\left(\frac{1}{n_i} + \frac{1}{n_j}\right) \cdot S_r^2}} ; \qquad p = 2,3.$$

The relevant tables were used for the determination of critical values of Duncan's test $D_{0,05}$ for the significance level $\alpha = 0,05$ for given p and given residual number of degrees of freedom 192-3 =189. These data were entered into the Table 8 together with the calculated values $D_{p,\alpha}$.

By means of these characteristics, there was tested the statistical significance of the particular arithmetic averages.

Table 8. The Critical Values of Duncan´s Test

p	$D_{p,critic}$	i, j	$D_{p,0,05}$
2	2,80	i = 1, j = 2	1,83
2	2,80	i = 2, j = 3	0,73
3	2,95	i = 1, j = 3	4,27

The results between the first and second sample: = 2, $D_{2,\alpha} = 1,83$;
$D_{2,\alpha} < D_{2,critic}$ thus differentia is not significant.
The results between the second and third sample: **p** = 2, $D_{2,\alpha} = 0,73$;
$D_{2,\alpha} < D_{2,critic}$ thus differentia is not significant.
The results between the first and third sample: = 3, $D_{3,\alpha} = 4,27$;
$D_{3,\alpha} > D_{3,critic}$ thus differentia is significant.

Result: There is a significant difference in learning outcomes between Grammar School and Secondary Technical School. However, there is no significant difference between Grammar School and Business Academy and between Business Academy and Secondary Technical School.

The results of the second semester also confirm that Grammar School students are best prepared for the studies at the university.

Verifying following research issues – Whether students with a higher number of lessons in computer science than two hours weekly (group 1) in a secondary school achieved better results in the Informatics 2 than students whose lesson allocation was equal or less than 2 lessons per week (group 2).

The study results are pointing out that the number of computer science lessons per week at secondary schools does not affect the learning results of Informatic 2. It is shown by the average grades of both student groups (Table 9).

Table 9. The Average Grade in the Exam Informatics2 according to the Number of Hours of Computer Science Lessons in a Secondary School per Week

Number of hours per week > 2	2,67
Number of hours per week <= 2	2,55

Evaluating the hypothesis statistically by T-Test for Two-Sample Assuming Unequal Variances with two independent samples n = 75, m = 118. For this reason there was tested the difference between the two groups by a two-sample location Student's t-test with unequal variances. There was tested the hypothesis H0: $\mu_1 = \mu_2$ versus H1: $\mu_1 \neq \mu_2$.

Results were in Excel file (Table 10).

Table 10. Results of T-Test Two-Sample Assuming Equal Variances

t-Test: Two-Sample Assuming Unequal Variances		
	Variable 1	Variable 2
Mean	2,76	2,52991453
Variance	1,536216216	1,47539051
Observations	75	118
Hypothesized Mean Difference	0	
df	156	
t Stat	1,264796754	
P(T<=t) One-Tail	0,103915192	
t Critical One-Tail	1,654679996	
P(T<=t) Two-Tail	0,207830384	
t Critical Two-Tail	1,975287508	

The value of test statistics is t = 1,2647 and P = 0,1039. When comparing it with the critical values of a t-test were obtained: t = 1,264 < $t_{0,05}(183)$ = 1,975.

The H0 hypothesis was not rejected. The selective average on the selected significance level does not differ from the value of the average of the basic file.

Comparison of Results after Passing the Subjects of Informatics 1 and Informatics 2

This section evaluates the results of the exams Informatics 1 and Informatics 2 of the 1st year of study. The aim was to find out how the student's results changed in the 2nd semester, the method used for this evaluation was t-Test: Paired Two Sample for Means (Table 11).

Table 11. t-Test: Paired Two Sample for Means

	1. sem.	2. sem.
Mean	2,653846154	3,417582418
Variance	1,641946451	2,178252687
Observations	182	182
Pearson Correlation	0,240451907	
Hypothesized Mean Difference	0	
df	181	
t Stat	-6,03919081	
P(T<=t) one-tail	4,29592E-09	
t Critical one-tail	1,653315758	

There was set up and tested the hypothesis:

H0 – the results in the 1st semester and 2nd semester are identical

compared to the hypothesis of

HA – the results in the 2nd semester are on average better compared to those in the 1st semester.

There was used t-Test: Paired Two Sample for Means.

The P-value of the test is approximately 4.3E-9; therefore, the hypothesis H0 was rejected and thus, HA is valid.

Thus, it has been shown that the student results in the second semester were significantly better than in the first semester. This confirmed the assumptions of the teachers who observed a significant improvement in the second semester lectures. Students work harder in exercises and lectures and communicate much more with educators and teachers.

4. Results

The first research issue was: Whether and to what extent can the type of secondary influence their 1st year study results in the subject Informatics 1?

Following results were achieved:

There is a significant difference in learning outcomes between Grammar School and Business Academy, and Grammar School and Secondary Technical School. Business Academy and Secondary Technical School do not have a significant difference in learning outcomes. It means that students from Grammar Schools are best prepared for university studies.

The second research issue was: Whether students with a higher number of lessons in computer science than two hours weekly in a secondary school achieved better results in the Informatics 1 than students whose lesson allocation was equal or less than 2 lessons per week.

There were obtained the following results: Students with a higher number of lessons in computer science than two lessons a week at a secondary school do not achieve better results in the Informatics 1 exam than students whose lesson allocation was equal or less than 2 hours a week.

The third research issue was: Whether and to what extent can type of secondary school influence their 1st year study results in the subject Informatics 2.

The results of the research demonstrated that is a significant difference in learning outcomes between Grammar School and Secondary Technical School. However, there is no significant difference between Grammar School and Business Academy and between Business Academy and Secondary Technical School. The results of the second semester also confirm that Grammar School students are best prepared for the studies at the university.

The fourth research issue was: Whether students with a higher number of lessons in computer science than two hours weekly at a secondary school achieved better results in the Informatics 2 than students whose lesson allocation was equal or less than 2 lessons per week.

It was confirmed – students of both samples had almost the same results.

The fifth research was set up and tested the hypothesis:

H0 – the results in the 1st semester and 2nd semester are identical.

compared to the hypothesis of

HA – the results in the 2nd semester are on average better compared to those in the 1st semester.

Grades in the 2nd semester shows that students consecutively get used to university load, they find the way to learn and work sufficiently so they are able to fulfill studying demands.

5. Discussion

Informatics is taught in schools only shortly. In the 1980's and the 1990's, IT education was implemented in many countries (Diethelm, Mittermeir, 2013) and due to the dynamics of IT development the curriculum of this subject often changes and therefore the results of research in teaching informatics are so far rare, despite the fact that good IT knowledge will become more and more important in the future. Teaching informatics has become important to successful study at university in many scientific disciplines and can essentially contribute to the success of young people in their working future (Hromkovič, Björn, 2011).

The research described in the article will serve as a basis for further progress in the teaching of Informatics at the PEDAS Faculty of the University of Žilina. Such research has never been done at the faculty It is unique and all its results are important for teachers.

The research points out that study results of university students are to a large extent influenced by a quality and type of a secondary school. Difference in the grades from both semesters are significantly better in favor of Grammar Schools which prepare students for studies at universities and graduates of these schools have better results in year-end tests compared to students from other schools (Tunega, 2019).

Secondary school students acquire not only knowledge but also learning habits that influence them especially at the beginning of their university studies (Šusteková, Kontrová, 2019).

Next important goal of the research was to find out whether more than two hours a week allocation of computer science lessons at secondary school leads to better outcomes in the subject Informatics at the university. The results of the students of both groups were comparable. Why is it like that? Students who had more than two hours a week allocation of computer science lessons in the first semester underestimated the subject, learned less and mastered the subject only with difficulties.

Another result of the research was encouraging for teachers – a comparison of the results obtained in 1st and 2nd semester.

The results of students in the second semester were significantly better than in the 1st semester, which indicates that the students learned to work systematically during the 1st semester and got used to the load of university curriculum. This was to a large extent supported by the approach of teachers.

According to university teacher's experiences, students in general don't have sufficient knowledge as well as studying habits. For example chancellor of Slovak Technical University decided to launch "zero year" which should prepare secondary school graduates for study at their university. It would be desired if secondary schools increase demands on teachers what will result in better quality of these schools. The teachers are most important. It is needed to have superior and devoted teachers and the education will improve (Mokošová, 2020).

In recent years were encountered several problems that affect not only the learning results but also the teaching process itself. More authors have addressed this issue. As was described in more detail in the Materials and methods of this article, one of the reasons may be narcissism (Podzimek, 2019: 489), which is a direct consequence of modernism as a result of industrialization.

According to (Twenge, Campbell, 2009), narcissism promotes false self-confidence in young people, which is not based on real knowledge and skills and can be a barrier to acquiring knowledge.

S. Alabdulkareem points to the massive use of devices connected to the Internet. These can detach students from the study and cause a number of problems such as inattention during class, cheating during the exam, the impact of web pages on knowledge and more (Alabdulkareem, 2018: 583).

Another reason why some students have difficulties in studying at a university may be the massification of higher education. As mentioned in the article of K. Vančíková (2019) however, it is a natural response of society to the new demands of the era and it is logical to assume that by the end of the 21st century the vast majority of the population will have higher education. It is a problem or challenge for university education worldwide, as evidenced by the authors' work of Deane E. Neubauer, D., E., Ka Ho Mok, Jin Jiang (2017).

5.1. Limitation

5.2. Among the selected groups (a total of 291 students), there were only 36 those who had more than 2 hours a week allocation of subject computer science, so the selections of the number of students in terms of statistical testing are very different.

Were used a two-sample t-test assuming equal variances for testing. The prerequisites for this test are data normality and the same variances for both selected groups. When these circumstances are met, the test is very resistant to different numbers of samples, e.g. in (Nist/Sematech, 2013) it is stated with the difference in the number of selections close to our case. (Alternatively, it would be possible to use the Welch t-test for different variances (Lyócsa et al., 2013), which has even fewer assumptions but similar strength).

5.3. The results of the survey serve to improve the teaching of Informatics at the PEDAS Faculty at the University of Žilina. For this reason, the area is limited to the faculty.

6. Conclusion

The research was done to analyze next main aims:

• Whether and to what extent can the type of secondary school influence the results of students in the subject Informatics in the 1st year of university study.

• Whether students with a higher number of lessons in computer science than two hours weekly achieved better results in the Informatics in the 1st year of university study.

• Comparison of Results after Passing the Subjects of Informatics 1 and Informatics 2.

These aims were deeply elaborated and divided in 5 more research issues in previous parts of the document.

The results show that students from Grammar Schools are best prepared for university studies in both semesters. Students with a higher number of lessons in computer science than two lessons a week at a secondary school do not achieve better results in the Informatics1 exam than students whose lesson allocation was equal or less than 2 hours a week in both semestres.

Grades in the 2nd semester shows that students consecutively get used to university load, they find the way to learn and work sufficiently so they are able to fulfill studying demands.

The results of the survey serve to improve the teaching of Informatics at the PEDAS Faculty at the University of Žilina and will be used to create the syllabus of this subject for future accreditation.

References

Alabdulkareem, 2018 – *Alabdulkareem, S.* (2018). Social media in education: The absent attendee. *Problems of Education in the 21st century*. 76(5): 583-586.

Diethelm, Mittermeir, 2013 – *Diethelm, I., Mittermeir, R.* (2013). Informatics in Schools. *6th International Conference on Informatics in Schools: Situation, Evolution, and Perspectives, Proceedings.*

Hauser, 2008 – *Hauser, J.* (2008). Štátny vzdelávací program pre 2. stupeň základnej školy v slovenskej republike , isced 2 – nižšie sekundárne vzdelávanie [State education program for 2nd stage of the elementary school in Slovak Republic, isced 2 – lower secondary education]. [Electronic resource]. URL: http://www.statpedu.sk/sk/filemanager/download/42 [in Slovak]

Hauser, 2008 – *Hauser, J.* (2008). Štátny vzdelávací program pre gymnáziá v slovenskej republike, "isced 3a – vyššie sekundárne vzdelávanie [State education program for grammar schools in Slovak Republic, isced 3a – higher secondary education]. [Electronic resource]. URL: http://www.statpedu.sk/sk/ filemanager/download/43 [in Slovak]

Hromkovič, Björn, 2011 – *Hromkovič, J., Björn, S.* (2011). Why Teaching Informatics in Schools Is as Important as Teaching Mathematics and Natural Sciences. In: lecture notes in computer science. Book series. Publisher Springer.

Lyócsa et al., 2013 – *Lyócsa, Š., Baumöhl, T., Výrost, T.* (2013). Kvantitatívne metódy v ekonómii II (Quantitative methods in economics II). Košice, Elfa.

Mokošová, 2020 – *Mokošová, Z.* (2020). New chancellor of Slovak Technical University: We offer students a year to teach them a secondary school curriculum.

Neubauer et al., 2017 – *Deane E. Neubauer, D., E., Ka Ho Mok, Jin Jiang* (2017). The Sustainability of Higher Education in an Era of Post-Massification. Series: Routledge Critical Studies in Asian Education, Monografia. London.

Nist/Sematech, 2013 – Nist/Sematech e-Handbook of Statistical Methods, 2013. DOI: https://doi.org/10.18434/M32189

Nový rektor STU… – Nový rektor STU: Študentom ponúkame rok, aby sme ich doučili učivo zo strednej. [Electronic resource]. URL: https://www.stuba.sk/sk/novy-rektor-stu-studentom-ponukame-rok-aby-sme-ich-doucili-ucivo-zo-strednej-dennikn.sk.html?page_id=13071. Dennikn, Bratislava. [in Slovak]

Podzimek, 2019 – *Podzimek, M.* (2019). Problems of narcissism in education: The culture of narcissism as a dangerous global phenomenon for the future. *Problems of Education in the 21st century.* 77(4): 489-501.

Šusteková, Kontrová, 2019 – *Šusteková, D., Kontrová, L.* (2019). How are high schools graduates prepared for informatics at university. *Proceedings of 12th annual International Conference of Education, Research and Innovation.* 4714-4720. Seville, Spain.

Tirpáková, 2011 – *Tirpáková, A.* (2011). Mathematics statistics, Monography. Nitra/Slovakia.

Tunega, 2019 – *Tunega, M.* (2019). Pozrite si aktuálne výsledky žiakov základných a stredných škôl [See the current results of primary and secondary school students]. [Electronic resource]. URL: http://www.ineko.sk/clanky/pozrite-si-aktualne-vysledky-ziakov-zakladnych-a-strednych-skol [in Slovak]

Twenge, Campbell, 2009 – *Twenge, J.M., Campbell, W.K.* (2009). The Narcism epidemic. New York, Simon and Schuster.

Vančíková, 2019 – *Vančíková, K.* (2019). Readiness of secondary schools graduates for universities. To dá rozum. Bratislava. [Electronic resource]. URL: htps//analyza.todarozum/docs/432871001mr1a/

Zuhair et al., 2019 – *Zuhair, A., Nabil, S., Najati, A.* (2019). Teachers carrying out their Professional Roles as View of Zarqa Town's Teachers. *European Journal of Contemporary Education.* 8(4): 715-725. DOI: 10.13187/ejced.2019.4.715