UNIVERSITY OF NOVI SAD
TECHNICAL FACULTY "MIHAJLO PUPIN"
ZRENJANIN
REPUBLIC OF SERBIA

INTERNATIONAL CONFERENCE ON

INFORMATION TECHNOLOGY AND DEVELOPMENT OF EDUCATION ITRO 2014

PROCEEDINGS

MEĐUNARODNA KONFERENCIJA

INFORMACIONE TEHNOLOGIJE I RAZVOJ OBRAZOVANJA ITRO 2014

ZBORNIK RADOVA

ZRENJANIN, JUNE 2014

Organiser of the Conference:
University of Novi Sad, Technical faculty „Mihajlo Pupin", Zrenjanin, Republic of Serbia

Publisher:
University of Novi Sad, Technical faculty „Mihajlo Pupin", Djure Djakovica bb, Zrenjanin, Republic of Serbia

For publisher:
Milan Pavlovic, Ph. D, Professor, Dean of the Technical faculty „Mihajlo Pupin", Zrenjanin

Technical preparation and design:
Ivan Tasic, Ph. D, Assistant Professor
Dijana Karuovic, Ph. D, Assistant Professor
Marjana Pardanjac, Ph. D, Assistant Professor
Erika Eleven, M.Sc, Assistant
Dusanka Milanov

Lecturer:
Erika Tobolka, Ph. D, Professor

Printed by:
Printing office DIGINET ProStudio, Djure Jaksica street, no. 14, Zrenjanin

Circulation: **60**

ISBN: 978-86-7672-225-9

By the resolution no. 114-451-970/2014-03, Autonomous Province of Vojvodina Provincial Secretariat For Science and Technological Development donated financial means for printing this Conference Proceedings.

The Conference is supported by the Autonomous Province of Vojvodina, the City Administration of Zrenjanin, The National House of Mihajlo Pupin, Idvor and Organizing Committee for the Anniversary of the "Mihajlo Pupin year".

CIP – Каталогизација у публикацији
Библиотека Матице српске, Нови Сад

37.01:004(082)
37.02(082)

INTERNATIONAL Conference on Information Technology and Development of Education (2014 ; Zrenjanin)
Proceedings = Zbornik radova / International Conference on Information Technology and Development of Education, ITRO 2014, Zrenjanin, June 2014 = Međunarodna konferencija Informacione tehnologije i razvoj obrazovanja, ITRO 2014 ; [organiser] University of Novi Sad, Technical Faculty "Mihajlo Pupin", Zrenjanin. - Zrenjanin: Technical Faculty "Mihajlo Pupin", 2014 (Zrenjanin: Diginet ProStudio). –
VII, 441 str. : ilustr. ; 30 cm

Tiraž 60. – Bibliografija uz svaki rad .

ISBN 978-86-7672-225-9
1. Technical Faculty „Mihajlo Pupin" (Zrenjanin)
a) Информациона технологија – Образовање – Зборници b)

Образовна технологија - Зборници
COBISS.SR-ID 287020807

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Erika Eleven, M.Sc, Assistant, Technical Faculty "Mihajlo Pupin" Zrenjanin, Republic of Serbia

Dusanka Milanov, Technical Faculty "Mihajlo Pupin" Zrenjanin, Republic of Serbia

With this publication, the CD with all papers from the International Conference on Information Technology and Development of Education, ITRO 2014 is also published.

We are very grateful to:

Autonomous Province of Vojvodina
The National House of Mihajlo Pupin, Idvor
Organizing Committee for the Anniversary of the
"Mihajlo Pupin year"

for donated financial means which supported printing of the Conference Proceedings and organizing of the Conference.

INTRODUCTION

This Proceedings comprises papers from the **International conference on Information technology and development of education** that is held in the National House of Mihajlo Pupin, Idvor on June 27th 2014.

The International conference on Information technology and development of education has had a goal to contribute to the development of education in Serbia and in the region, as well as, to gather experts in natural and technical sciences' teaching fields.

The expected scientific-skilled analysis of the accomplishment in the field of the contemporary information and communication technologies, as well as analysis of state, needs and tendencies in education all around the world and in our country have been realized.

The authors and the participants of the Conference have dealt with the following thematic areas:

- Theoretical and methodological questions of contemporary pedagogy
- Personalization and learning styles
- Social networks and their influence on education
- Children security and safety on the Internet
- Curriculum of contemporary teaching
- Methodical questions of natural and technical sciences subject teaching
- Lifelong learning and teachers' professional training
- E-learning
- Education management
- Development and influence of IT on teaching
- Information communication infrastructure in teaching process

All submitted papers have been reviewed by at least two independent members of the Science Committee.

The papers presented on the Conference and published in this Proceedings can be useful for teacher while learning and teaching in the fields of informatics, techniques and other teaching subjects and activities. Contribution to science and teaching development in this region and wider has been achieved in this way.

The Organizing Committee of the Conference

CONTENTS

STRUCTURAL EGUATION MODELING AND THEIR APPLICATION IN EDUCATIONAL RESEARCH - CASE STUDY OF ICT USAGE IN PRIMARY SCHOOLS IN SOUTH - EAST REGION IN MACEDONIA

V. Vitanova[*], T. Atanasova-Pachemska[*], S. Pachemska[**]
[*]Faculty of Computer Science, University "Goce Delcev" Stip, R. Macedonia
[**]Bureau for Development of Education of the Republic of Macedonia, Skopje, R. Macedonia
vasilka_v@yahoo.com, tatjana.pacemska@ugd.edu.mk

Abstract - A research was conducted in order to ensure valid and reliable assessment of the extent of ICT knowledge and skills of teachers in primary schools, to identify the factors in terms of teachers affecting the development of ICT competences, and to identify strategies to improve the development of effectiveness in the future.

The research surveyed 214 teachers from 10 primary schools in the Southeast region of Macedonia . The Technique Modeling with Structural Equations was used to determine the relative strength of influence of factors on ICT competencies of teachers and the relative strength of the factors affecting the frequency of use of ICT in teaching. The results show that 25% of the teachers have below basic ICT Competency, 17% of teachers have basic knowledge and skills to operate a computer, and the highest percentage, 58% of teachers with proficient ICT competence. The highest percentage of 58.4 % of the teachers often use ICT in teaching, 33.6 % rarely use ICT, 7 % of respondents use ICT at all times, and only 0.9 % do not use ICT for teaching purposes.

The survey results were analyzed using SPSS 19, Excel and Amos Graphics 18.

I. INTRODUCTION

Information and communication technologies (ICT) play a proven critical role in enhancing the quality of education. They are particularly important in helping teachers and students to perform more effectively. To make the best use of ICT, teachers must be equipped with adequate ICT competencies. In the process of integrating ICT into education, both teacher's ICT competencies and how they perceive the role of ICT in their teaching/learning processes play key roles. Analysis, design, development, implementation, evaluation, and management of ICT in education require diversified competencies and knowledge (Kozma 2002, pp.1-6).

ICTs have become within a very short time, one of the basic building blocks of modern society. Many countries now regard understanding ICT and mastering the basic skills and concepts of ICT as part of the core of education, alongside reading, writing and numeracy (Daniels, 2002).

Today, improved communication technology has made time and space less complex. It could be observed that this modern age is the age of information explosion in which an average individual wants to explore the information system. Thus, the ability for timely acquisition, utilization, communication and retrieval of relevant and accurate information has become an important attribute for better teaching-learning process (Adebayo, 2008).

The new technologies have the potential to support education across curriculum and provide opportunities for effective communication between teacher and students in ways that have not been possible before. ICT in education has the potential to be influential in bringing about changes in ways of teaching (Dawes, 2001).

The field of education has been affected by ICTs, which have undoubtedly affected teaching, learning, and research (Yusuf, 2005). A great deal of research has proven the benefits to the quality of education (Al-Ansari, 2006). ICTs have the potential to innovate, accelerate, enrich, and deepen skills, to motivate and engage students, to help relate school experience to work practices,

create economic viability for tomorrow's workers, as well as strengthening teaching and helping schools change (Davis and Tearle, 1999; Lemke and Coughlin, 1998; cited by Yusuf, 2005). As Jhurree (2005) states, much has been said and reported about the impact of technology, especially computers, in education The field of education has been affected by ICTs, which have undoubtedly affected teaching, learning and research (Yusuf, 2005) .ICTs have the potential to accelerate, enrich, and deepen skills, to motivate and engage students, to help relate school experience to work practices, create economic viability for tomorrow's workers, as well as strengthening teaching and helping schools change (Davis and Tearle, 1999; Lemke and Coughlin, 1998; cited by Yusuf, 2005).

Teachers contribute toward the base of the education innovation, therefore ICT competencies of teachers in primary schools should be seen as an invaluable prerequisite to facilitate teaching and learning in this modern era of information and technology. [9]

ICT is not only a means of realizing the educational goals but important factor in a complete restructuring of the educational system, introducing new interactive and participatory models of education, new educational pedagogy, continuous and lifelong learning.

Macedonian context of computerization and digitization of education intensively developed after 2002 when the country received the first Chinese donation, which allowed a certaindegree of popularization of ICT in the education. Starting in 2003 through the e-school project teacher training the use of ICT were conducted in two phases. With changes in education that occurred with the intensive introduction in education, resulted in a need to develop national educational policies and strategies that will contribute to the social and educational development. In 2005 was created the draft program for the development of ICT in education (2005-2015) which covered the process of computerization and digitization of education.

Macedonia entered the world of ICT innovation with the introduction of the program "Computer for Every Child" initiative and investment by the Government of the Republic of Macedonia to modernize Macedonian education. This project provides a computer for each child, software solutions and tools for each subject, advanced ICT skills among teachers and students, a national system of testing students and the interactive online teaching.

In the academic year 2009/2010, primary schools were equipped with portable Classmate PCs for every student from first to third grade. In 2010 teacher trainings were conducted for Edubuntu operating system, the programs for integration of mathematics and sciences, ToolKid program and SSTC of using “thin clients”. Furthermore, despite the software electronic grades were introduced. Also attached is training for class teachers for the program and Green G Compris suite-junior. [5,6,8]

Starting from the academic year 2013/14, all teachers were required to integrate at least 30% of ICT in the curriculum.

II. METHODOLOGY

In the survey every teacher had to report their ICT knowledge and skills, the ways in which they use ICT in teaching, ICT trainingthey have attended, frequency of ICT use in teaching and to evaluate motivational attitudes of the ICT use in teaching, and the attitudes of the school towards ICT. The main parts of the survey are shown in Table 1.

This research is done in order to ensure a valid and reliable assessment of the extent and nature of ICT knowledge and skills of teachers in primary schools, and to identify factors that affect the frequency ICT usage in teaching.

The survey was conducted in the academic year 2012/13, in 10 primary schools in the Southeast region of the Republic of Macedonia in the municipalities of Strumica, Vasilevo, Bosilevo and Novo Selo. The survey was conducted on 214 teachers, a representative sample in given that 610 is the total number of teachers in those municipalities.

TABLE I. STRUCTURE OF THE ICT SURVEY IN TEACHING FOR TEACHERS IN PRIMARY SCHOOLS

part	Title of section	Information	Number of issues
I	General information	environment, age, experience, sex, teacher	5
II	Using the computer for personal needs	personal computer, type of computer, Internet at home, years of experience with computer	4
III	Personal and professional development	training classes at school, additional training, self-improvement	3
IV	Using computers at school	implementation of ICT programs, type of computer, hardware, use of computer	6
V	Motivation for using ICT in teaching	motivational view with scale assessment	21
VI	ICT knowledge and skills	navigation in the operating system, email, Internet, text editor, multimedia presentations, spreadsheet calculations, blogs, databases	8
VII	ICT in school	assessment scale for the application of ICT in school	3
		Total Questions	33

III. RESULTS AND DISCUSSION

The survey results were analyzed using SPSS 19 programs, Excel and Amos Graphics 18. The tables below present the demographic characteristics of the surveyed teachers.

TABLE II THE LOCATION OF THE SCHOOL

Location

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Rural	105	49,1	49,1	49,1
	Urban	109	50,9	50,9	100,0
	Total	214	100,0	100,0	

Table II shows that almost equal number of teachers are from urban and rural areas.

TABLE III AGE STRUCTURE OF THE SURVEYED TEACHERS

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<=25	5	2,3	2,3	2,3
	>=56	24	11,2	11,2	13,6
	26-35	59	27,6	27,6	41,1
	36-45	55	25,7	25,7	66,8
	46-55	71	33,2	33,2	100,0
	Total	214	100,0	100,0	

TABLE IV WORK EXPERIENCE AS A TEACHER.

Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<=5	46	21,5	21,5	21,5
	>=26	51	23,8	23,8	45,3
	11-15	29	13,6	13,6	58,9
	16-20	22	10,3	10,3	69,2
	21-25	19	8,9	8,9	78,0
	6-10	47	22,0	22,0	100,0
	Total	214	100,0	100,0	

TABLE V GENDER OF SURVEYED TEACHERS

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	177	82,7	82,7	82,7
	Male	37	17,3	17,3	100,0
	Total	214	100,0	100,0	

TABLE VI TEACHERS FROM PRIMARY EDUCATION.

Teacher

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary education teacher	85	39,7	39,7	39,7
	Subject teacher	129	60,3	60,3	100,0
	Total	214	100,0	100,0	

In the survey the teachers responded regarding their use of eight most used ICT applications:

- Navigation in OS
- Electronic mail
- Internet
- Text editor (Word, OpenOffice Writer, ...)
- Multimedia presentations (Power Point, OpenOffice Impress, ...)
- Spreadsheets (Excel, OpenOffice Calc, ...)
- Blogs
- Databases

For each software application was given a list of skills that teachers chose the ones they posses.

The use of ICT applications by teachers is different, as shown in Table 7.

TABLE VII USE OF ICT APPLICATIONS BY TEACHERS

	Percentage of use *
Base: All respondents	n=214
Navigation in OS	90%
Email	89%
Internet	94%
Text editor (Word, Open Office Writer ...)	94%
Multimedia presentations (Power Point, Open Office Impress ...)	81%
Spreadsheets (Excel, Open Office Calc ...)	79%
Blogs	10%
Databases	4%

* Percentage of teachers who said they use the application

The Basic ICT applications which are used by 94% of the teachers are online and text editor. The application navigation in operating system was used by 90%, email by 89%, and multimedia presentations by 81%. Then, spreadsheets used by 79%, and blogs used by only 10% of the respondents. The lowest percentage of respondents 4% are using databases for the purposes of teaching.

In order to provide an easier way of applying statistics, the results of the survey were summarized for ICT competencies. Each of the answers for the given eight skills to work with a computer was assigned a score. The total number of points gives the result for ICT competence.

The results of ICT competences are given in Figure 1. The graph shows that 25% of the teachers have the least ICT Competency, with less than 40 points. 17% of teachers have 41 to 70 points for the knowledge and skills of computer operation, and the highest percentage, 58% of teachers got 71 of the 129 points for ICT skills. So we can conclude that most teachers have high ICT competence, then teachers who have acquired basic knowledge and skills to work with a computer, the teachers in the middle are the least.

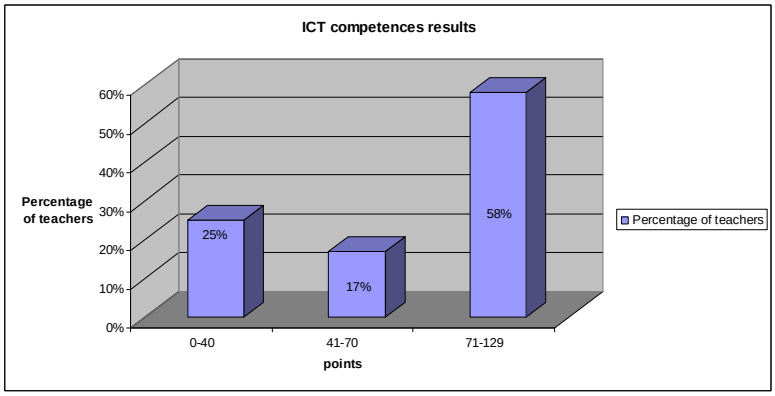

Figure 1. Graphical representation of the ICT competences results

When analyzing the results of ICT competence we came to some key factors that influence the teachers' ICT knowledge and skills. This decision is useful for the future when providing recommendations for the development of ICT knowledge and skills.

Factors found to affect the ICT knowledge and skills of teachers will be considered as:

- demographic factors and
- other factors.

The following demographic factors have a significant relationship with the teacher's ICT competence.

- **Gender:** Men are more likely to have higher ICT competence than women .
- **Age:** ICT competence score decreases as age increases for teachers .
- **Work experience:** The results of ICT competence score decrease as the experience of teachers in years increase, this undoubtedly is due to the relationship between age and experience of teaching.
- **Subject / elementary teacher:** The teachers teaching subjects are more likely to have higher scores in ICT competence than teachers in elementary school.

A factor which is not significantly associated with ICT competence (ie no statistically significant relationship exist between this factor and the results of ICT competence) is:

The location of the school (urban or rural)

Technique Modelling with Structural Equations was used to analyze the relationship between ICT knowledge and skills of teachers and the factors that influence them. Structural equation modelling examines the strength of the relationship between variables and assigns weight ratio, which could be anywhere between 0 and 1. It was found that the strongest factors related to ICT knowledge and skills are: professional use of ICT, school ICT capacity, personal computer, teacher attitudes and motivation. These relationships are shown in the model below.

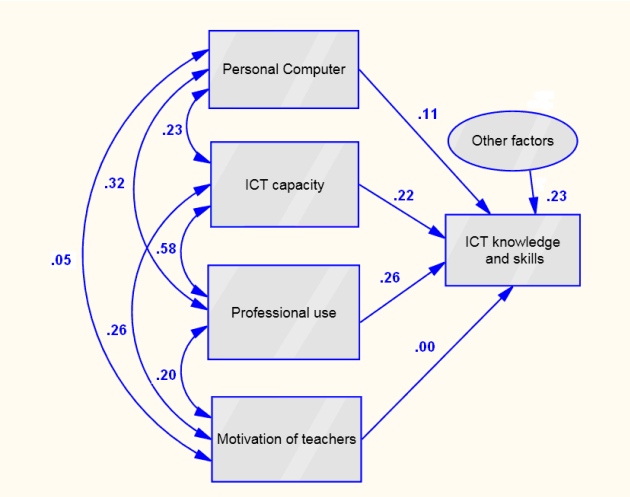

Figure 2. Relative strength of influence of factors on ICT competencies of teachers

From Figure 2 we can conclude that the professional use is the strongest impact factor of ICT knowledge and skills, which measured 0.26, then comes ICT capacity of 0.22, personal computer measured 0.11, but the motivational factor, which measured 0.004 is negligible. The impact of other factors on ICT knowledge and skills is 0.23.

When we collect the results of all factors that influence the ICT knowledge and skills we get a value 0.604 (0 to 1). This means that all these factors are 60.4% of the variance of ICT knowledge and skills and suggests that these factors describe well the impact on ICT knowledge and skills.

TABLE VIII REGRESSION WEIGHT FACTORS FOR ICT KNOWLEDGE AND SKILLS

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
ICT knowledge and skills	<---	Personal Computer	13.443	7.510	1.790	.073	
ICT knowledge and skills	<---	ICT capacity	5.043	1.723	2.927	.003	
ICT knowledge and skills	<---	Professional use	4.024	1.158	3.475	***	
ICT knowledge and skills	<---	Motivation of teachers	.208	3.663	.057	.955	

TABLE IX OVERVIEW OF THE MODEL IN SPSS

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,480[a]	,231	,216	33,734

a. Predictors: (Constant), Motivation of teachers, Personal computer, ICT capacity, Professional use

Table 9 gives us a summary of the model in SPSS, where we can see that the value of R Square is 0.231 indicating that the model is correct.

Figure 3 is a graphical representation of a given application of ICT in teaching. The question: Do you use ICT in teaching, teachers had to answer whether they do it all the time, rarely, never, or don't know what it is. The largest percentage of 58.4% reported that they use ICT often, 33.6% rarely use ICT, 7% of the respondents use ICT at all times, and only 0.9% do not use ICT for teaching purposes.

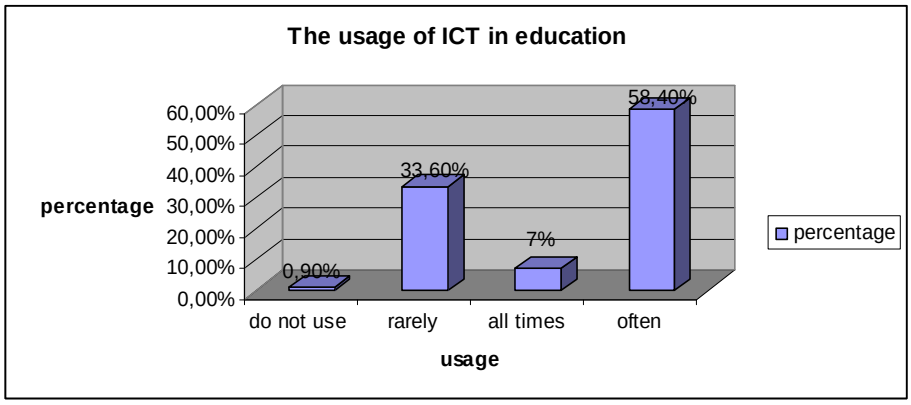

Figure 3. The usage of ICT in education

The survey asked teachers who use ICT in teaching to also assess the frequency, i.e. if they apply it daily, weekly, monthly, or a few times a year. Figure 4 shows the frequency of ICT usage. The largest percentage of 49.10 % applied ICT weekly, 20.60 % applied ICT monthly, 17.80 % a few times a year, and the smallest percentage of 11,70 % use ICT every day. The frequency of ICT usage in teaching depends on the nature of the subject that the teacher teaches and the requirements for the application of ICT in the teacher's curriculum.

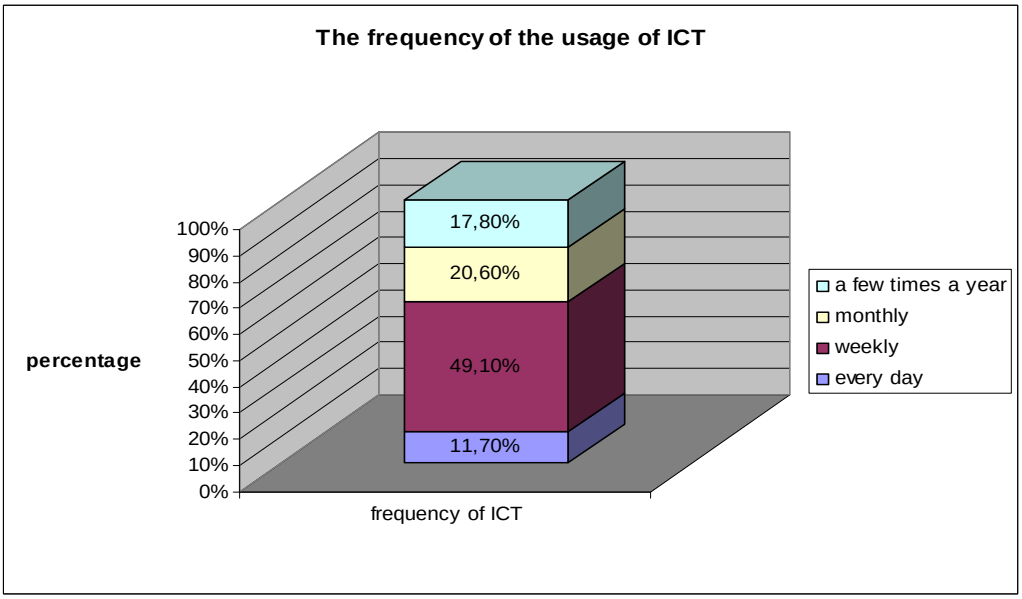

Figure 4. The frequency of the usage of ICT

According to the frequency of ICT usage, the teachers can be classified into three categories: low, medium and high. The low category, 34.1% of the surveyed teachers, includes teachers who rarely or never use ICT and if they do use it, it is a few times a year or month. The medium category, involved the highest percentage of respondents 52.3%, includes teachers who often use ICT in teaching. The high category, involved the lowest percentage of 13.5 % respondents, includes teachers who use ICT at all times, or every day.

By analyzing all demographic factors such as gender, environment, age, seniority, years of experience, and the kind of teacher we cannot single out any demographic factor that shows statistically significant correlation with the frequency of ICT usage in teaching.

The technique of structural equation modeling was used again to analyze the relationship between the frequency of ICT usage and the other factors.

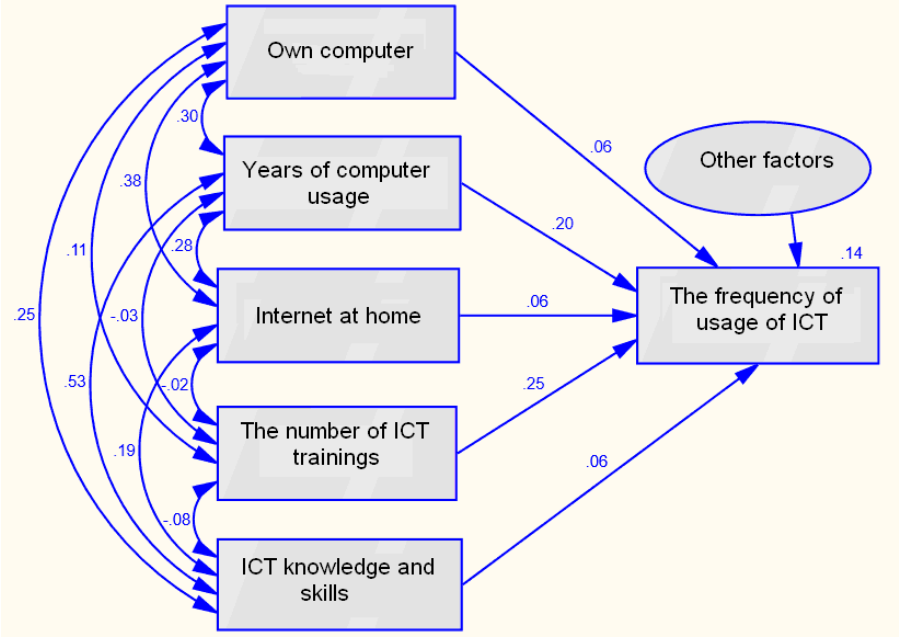

Figure 5. The relative strenght of influence on the factors on the frequency of usage of ICT

From Figure 5 we can conclude that the number of ICT trainings is a factor with the strongest influence on the frequency of ICT usage - measured 0.25, then comes years of computer

usage - measured 0.20, and the remaining three factors: own computer, have Internet at home, and have ICT knowledge and skills - measured 0.06. The impact of other factors on ICT knowledge and skills is 0.14.

When we add the results of all five factors that influence the frequency usage of ICT, we obtain value 0.63 (0 to 1). This means that all these factors are 63% of the variance in frequency of ICT usage, suggesting that these factors describe the impact on frequency of ICT usage well.

TABLE X THE REGRESSIONAL WEIGHT OF THE FACTORS FOR THE FREQUENCY IF THE USAGE OF ICT.

Regression Weights: (Group number 1 – Default model)

			Estimate	S.E.	C.R.	P	Label
The frequency of ICT usage	←-	Own computer	.266	.325	.818	.414	
The frequency of ICT usage	←-	Years of computer usage	.289	.110	2.636	.008	
The frequency of ICT usage	←-	Internet at home	.373	.464	.804	.421	
The frequency of ICT usage	←-	Number of ICT training	.238	.060	3.964	***	
The frequency of ICT usage	←-	ICT knowledge and skills	.002	.003	.758	.449	

Table 10 is a textual display of the results using AMOS Graphics. As we can see only the factor *Number of ICT training* has a significant positive effect on the frequency of ICT usage, with value of p <0.001. Years of computer usage have a positive significant effect on the frequency of ICT usage, with value of p <0.05. The rest of the factors have a positive insignificant effect on the frequency of ICT usage, with a value of p greater than 0.05.

TABLE XI OVERVIEW OF THE MODEL IN SPSS.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0,380[a]	0,144	0,124	1,376

a. Predictors: (Constant), ICT knowledge and skills, Number of ICT training, Internet at home, Own computer, Years of computer usage

Table 11 gives us a summary of the model in SPSS, where we can see that the value of R Square is 0.144, indicating a good model.

TABLE XII ANOVA table for the cumulative effect on SPSS.

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	66,457	5	13,291	7,018	0,000[a]
	Residual	393,917	208	1,894		
	Total	460,374	213			

a. Predictors: (Constant), ICT knowledge and skills, Number of ICT training, Internet at home, Own computer, Years of computer usage
b. Dependent Variable: The frequency of usage of ICT

As we can see from the ANOVA table, the cumulative effect is significant.

TABLE XIII TABLE OF COEFFICIENTS IN SPSS.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1,060	0,479		2,213	0,028
	Own computer	0,266	0,329	0,058	0,808	0,420
	Years of computer usage	0,289	0,111	0,204	2,605	0,010
	Internet at home	0,373	0,470	0,056	0,795	0,428
	Number of ICT training	0,238	0,061	0,255	3,917	0,000
	ICT knowledge and skills	0,002	0,003	0,057	0,749	0,455

a. Dependent Variable: The frequency of usage of ICT

From Table 13 we see that the the Beta coefficients of all predictors are positive, but only Number of ICT training and years of computer use are significant, the rest of the factors are insignificant.

IV. CONCLUSION

Since the ultimate goal is to achieve a higher level of ICT competence of teachers, then using the factors that contribute as a guide is a step forward. The increase in professional use of ICT will positively affect the increase of ICT competencies of teachers. The key areas are:

- contacting colleagues online
- creating class materials by using web resources, consumables, software etc.
- administration

Continualy improving the technical equipment in the schools that will positively affect the use of ICT by teachers. Access to hardware and computers contribute to greater development of ICT competencies of teachers.

Motivational attitudes of teachers in general are positive and indicate a need for small improvement.

Training teachers regarding spreadsheets, multimedia presentations, blogs and databases will have a positive impact on ICT knowledge and skills of teachers in the corresponding areas.

Since the ultimate goal is to achieve higher frequency of the ICT usage in teaching, then according to the factors that contribute to it, are moving a step forward.

- Increased ICT competencies of teachers positively influence the increase of frequency ICT usage in teaching.
- Certainly the experience of working with computer positively affects the increase of ICT competencies of teachers, and thus the frequency of ICT usage in teaching.
- Increased number of training courses and similar improvements increase the frequency of ICT usage in teaching.
- The use of Internet at home does not limit a teacher to work in preparation for teaching and contributes to increase of the frequency of ICT usage in teaching.
- Having computer certainly has a positive influence on the frequency of ICT usage in teaching.

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