LANGUAGE BARRIERS IN TEACHING COMPUTER SCIENCE

Ljiljana Krneta[1], Tamara Grujić[2]

[1] Preschool Teaching Training College in Kikinda, ljiljana@businter.net
[2] Preschool Teaching Training College in Kikinda, tamaragrujic77@gmail.com

Abstract

This paper presents a small part of a broader study about barriers to teaching computer science in gymnasiums. Barriers to teaching communication can be *linguistic* or *language* barriers , due to the translation from English, selection of unfamiliar technical terms in teachers` speech, due to the use of foreign words and phrases, unfamiliar words in textbooks. The survey has lasted two years and it has included sample data of 1200 respondents – primary school final year pupils, gymnasium pupils and undergraduate students who had previously completed gymnasium. In teaching computer science, several types of barriers were detected and they were based on students` evaluations, assessments and on interviewing techniques. The detected language barriers have low intensity, they permeate all other barriers: educational, psychological, technical, ergonomic, socioeconomic, and they vary depending on the demographic characteristics of the respondents. Data were analyzed by using statistical methods and criterion by Gutman-Kaiser for determining relations among variables, which is called multiple regression factor, was applied.

Keywords: *language barriers, teaching computer science, evaluation, students.*

Introductıon:

Teaching in general, and the teaching of computer science can be organized and therefore studied in terms of cybernetic didactic theory, in other words, system`s theory and communication models. The basic elements of this communication system are: students, teachers, teaching contents and information and communication technology. In our research, teaching is seen as a communication process which has factors that are interfered with a variety of barriers that adversely affect the quality of teaching and learning outcomes, the information won`t become a part of student`s knowledge, because he/she can`t imagine it and understand it.[1] Depending on the criteria, barriers can be classified into the following categories: educational (didactic and methodical), psychological, language (linguistic), social, economic, demographic, technical, communicational, ergonomic, physical, external, internal, and other barriers.

[1] "Overcoming communicational barriers is everyone`s need and obligation, this particularly applies to the people who are responsible for establishing the effective communication system" (Bojanić, 2010).

Technical and ergonomic barriers – the most important are those related to school technical resources: limited equipment, a small number of computers, outdated computers, the costs and unavailability of appropriate forms of technology, access/ availability of resources during extracurricular activities (classrooms with computers, the internet, required software), and others.

Pedagogical (methodological-didactic) barriers – a big difference in the number of lessons of teaching computer science and computing and other IT subjects in secondary schools which have different or similar curriculums, outdated contents in the current curriculums, textbooks which are too extensive and which are not age-adjusted, pedagogical style of teachers, inadequate supervision and individual approach to a student, and others.

Socioeconomic and demographic barriers show that there are less classrooms with computers, high quality equipment, necessary textbooks and that internet is generally inaccessible in schools in economically isolated towns and villages; that students from these places are on the lower end of socioeconomic ladder, and therefore IT technology is mostly inaccessible for them.

Psychological barriers are irrational fears among students who did not have computer science subjects in high school or had a small number of lessons, and because of that they feel insecure when they use computers: the fear of causing some damage to the computer, embarrassment/ shyness related to improper use of computers and various prejudices (they are not talented in technology, computers are harmful to health, etc.).

Language barriers are related to the problem of software language during the communication with English-speaking person, especially for the students who did not learn this language or have insufficient knowledge of English; different linguistic IT terms which have the same meanings (folder – direktorijum, datoteka – fajl (file), and so on) , which leads to confusion in learning; incomprehensible expert academic terms during teachers` speeches, lack of examples and explanations in textbooks, unfamiliar terms and other communicational obstacles. Based on student evaluations, several barriers that hinder the teaching of computer science were detected. This paper will present the results of research related to language barrier.

1. Communication Processes and Systems Theories

Systems` theories have been criticized because of their generality and inability to explain real events within a broad framework. It is also believed that these theories "speak" abstract language, which does not provide a theoretical thinking. On the contrary, believers of this theory think that their openness is one of their benefits, because it does not allow the researcher to choose in advance and exclusively only one side "it`s about a great openness which can lead to the use of different logics, which are mutually inconsistent" (Janicijevic, 2000). According to these opinions, systems theories promote the researches that look at things as they are without imposing arbitrary theoretical categories (Janicijevic, 2000, by: Littlejohn, S., W., 1992).

Janicijevic argues that "these theories can be understood as a general access to everything. System theories most directly and most thoroughly discuss the communication from the perspective of the overall process".

Exploring cultural phenomena as communication processes, Umberto Eco pointed out that when individual messages were organized as factors of the communication process, they became intelligible in relation to certain codes. The question that he asked on that occasion was whether the wish that all cultural phenomena were viewed as communication phenomena was rational or intellectual idleness.

Regardless of the conflicting opinions, we ventured observe the language barriers in teaching computer science, and also in IT education through systems theory and communication processes.

Besides linguistics, psycholinguistics and sociolinguistics, as three main language theories, interest in language is evident in various branches of computer science and information technology. Computerized linguistics deals with the description and explanation of formal languages and it covers a wide range of activities related to the computer. The field of artificial intelligence is most interested in research related to language, particularly after the publication of Noam Chomsky's works (1957) about grammar and the ways mathematically of precise description and formulation of language (Janicijevic, 2000, p 120-121).

2. Results of the research of language barriers in teaching computer science

The research in this work is based on the importance (acceptance, respect) of students' points of view. Studies have lasted for two years, from 2008 to 2010, and they were conducted in gymnasiums in eight towns in Vojvodina, and the sample was composed of 1200 respondents. Besides gymnasium pupils, pilot research included primary school final year pupils and undergraduate students who had previously completed gymnasium. The pilot study included 162 primary school students and 168 gymnasium students from several towns and villages, and the general study included gymnasium final year students, a total of 817 students. The students who had completed gymnasium education evaluated the teaching of computer science in hindsight, and also in the aspects of computer foreknowledge necessary for college.

The general hypothesis of the research was: there are barriers in gymnasiums` education of computer science that affect the quality and effects of teaching. The reductions and elimination of detected barriers will improve the quality and effects of teaching computer science.

Measuring instrument is specifically designed for this study, it is a questionnaire-scale for assessment of barriers in the classroom. The scale is Likert-type, with 80 items.

Methods of data analysis: data obtained in this study were analyzed in the statistical package SPSS. The following statistical methods in data processing were done:

− by using analysis of the main components (Principal Component Analysis), the reduction of the initial set of variables was performed and the latent structure of space measurement of scale barriers in teaching computer science was analyzed.

− by using analysis of multiple regression, the relations with successfulness in courses where computers and IT knowledge were used and barriers in teaching and the use of computers were identified.

The following factors were featured:

F1 − inadequate attitude of teachers – pedagogical barriers;
F2 − technical and ergonomic barriers;
F3 − demographic barriers;
F4 − language barriers;
F5 − psychological barriers (negative attitude towards computers and course);
F6 − socioeconomic barriers.

Chart 1. The matrix of inter-correlation of factors:

Factors	1	2	3	4	5	6
F1	1,000	**,294**	**,274**	**,317**	- ,048	,072

F2	**,294**	1,000	,089	**,297**	,014	- ,046
F3	**,274**	,089	1,000	**,272**	- ,086	- ,075
F4	**,317**	**,297**	**,272**	1,000	- ,098	- ,016
F5	- ,048	,014	- ,086	- ,098	1,000	- ,093
F6	,072	- ,046	- ,075	- ,016	- ,093	1,000

Based on the matrix of mutual correlation factors, we can say that the factors are not mutually highly correlated or that they are not correlated statistically significantly, which means that some sub-dimensions are not significantly intertwined with the subject of measurement. The low correlation coefficients are between the first factor and the second, the third factor and the fourth factor, and the second and the third factor compared to the fourth factor.

Characteristics of the measuring instrument In order to determine psychometric characteristics, the following coefficients were calculated:

ALFA – a classic measure of reliability (according to Crombach, Kaiser).

LAMDA 6 – measure of the reliability of the test by Guttman`s model.

RHO1 and **RHO2** – lower and upper reliability limits (Momirovic).

MSA – Measure of Sampling Adequacy.

HOM – Momirovic`s coefficient of homogeneity.

Chart 2: *Metric characteristics of sub-dimensions of questionnaire*

	F1	F2	F3	**F4**	F5	F6
Alpha	0,82	0,85	0,85	0,82	0,84	0,81
Lamda 6	0,79	0,82	0,82	0,80	0,81	0,77
Rho1	0,75	0,82	0,85	0,76	0,72	0,62
Rho2	0,89	0,81	0,77	0,76	0, 91	0,95
MSA	0,86	0,77	0,77	0,83	0,96	0,88
Hom	0,85	0,91	0,69	0,84	0,96	0,81

Total Alpha coefficient for the entire scale of values is = 0.83 which indicates satisfactory reliability of the measuring instrument.

Validity – Factor loading matrix shows that it is an instrument that separates many aspects (factors) of the measured phenomena. Loads on the main components are generally not very high, but they are satisfactory, so if we see them as indicators of validity, we can say that the instrument is sufficiently valid for the derivation of scientific facts, although, of course, more valid measures of obtained dimensions could be constructed.

Reliability – Reliability does not meet the strictest criteria, since there is no scale with alpha coefficient which is above 0.90, but it can be considered satisfactory, although the instrument should be re-evaluated and its psychometric properties should be checked by using a representative sample. Its scale of reliability, according to Gutman`s model, does not meet the strictest criteria as well, but it is acceptable.

Representativeness – The representativeness of the items is expressed by MSA coefficient, its fifth sub-dimension has a high level and falls into the category that Kaiser considers to be the best; the first, the fourth and the sixth are slightly lower and fall into the category of creditable, and the second and the third sub-dimensions fall into the category of considerable. Representativeness shows that subscales are good representatives of the universe of the manifestations` appearances of that measure.

Homogeneity – Momirovic`s parameter of homogeneity is the lowest in the third sub-dimension, while other sub-dimensions are quite high.

Items` discrimination – was assessed on the basis of item – total correlation. The values of item – total correlations are not high, but they are acceptable in a large number of items, with a portion of the items that have less than optimal level, which is between 0.3-0.8.

The detected language barriers had lower intensity and they were associated with the uncertainty related to English proficiency, lack of understanding of the abbreviation for computer concepts and expert terminology in computer science textbooks. Besides, students perceived unfamiliar words in the computer science textbooks and during teachers` explanations.

Table 3: The precis from the matrix structure of the fourth (F4) factor:

The items` content:	F4
It would have been much easier to work on computers if everything hadn`t been in English	,655
In my class, the students with better proficiency in English, are more familiar with work on computers	,370
While I am listening to the teaching of computer science, it is bothering me because different terms are used for the same thing (for example, folder or direktorijum)	,575
I understand computer abbreviations (for example, RAM, ROM, FTP, CD-R, doc.)	,362
The teacher of computer science often uses words that I do not understand ,443 It often happens that I do not understand some words in the textbook of computer science	,510
It bothers me because during the lessons of computer science, I can`t freely express my opinion	,588

The fourth factor gathers the items that speak of language barriers in the teaching of computer science. This factor is significantly correlated with the following statements in the items:
“It would have been much easier to work on computers if everything hadn`t been in English”, “It often happens that I do not understand some words in the textbook of computer science”, “It bothers me because during the lessons of computer science, I can`t freely express my opinion”, “While I am listening to the teaching of computer science, it is bothering me because different terms are used for the same thing (for example, folder or direktorijum)” and so on. The students who achieve high scores at this factor, have problems with computer terminology, abbreviations, lack of English proficiency, lack of understanding of the material and the like, and this factor is called **the language barriers** in the teaching of computer science.

The tables below (from number 4 to number 10) show the extracted results analyzed by descriptive statistics (frequencies and percentages), in other words, the items from the questionnaire with questions related to the detection of language barriers.

Language (and terminological) barriers: “While I am listening to the teaching of computer science, it is bothering me because different names are used for the same thing (for example, folder or direktorijum)” (the example of the item from Table 3). Of the total number of 812 students, 214 answered “partially true” and “completely correct”, which is approximately 26 % of the students:

Table 4

While I am listening to the teaching of computer science, it is bothering me because different terms are used for the same thing (for example, folder or direktorijum) .									
completely untrue		**partially incorrect**		**hesitant**		**partially true**		**completely true**	
226	27.7 %	116	14.2%	256	31.3%	112	13.7 %	102	12.5 %

The example from the table No. 5 shows that the item – statement about understanding of computer abbreviations has been unexplained in IT education for a long time. Students commented that a shortened sentence (name, label) was often unexplained. Of the total number of 813 students, 372 answered "partially true" and "completely correct", which is approximately 45 % of the students:

Table 5

I understand very well computer abbreviations (for example doc . RAM , ROM , FTP , WWW) .									
completely untrue		**partially incorrect**		**hesitant**		**partially true**		**completely true**	
132	16.2%	109	13.3%	200	24.5%	208	25.5%	164	20.1%

The examples from the table No. 6 and No. 7 show the descriptive processing of the items – the statement about students` problems in relation to English proficiency in computer:

Table 6

It would have been much easier to work on computers if everything hadn`t been in English.									
completely untrue		**partially incorrect**		**hesitant**		**partially true**		**completely true**	
331	40.5%	111	13.6%	149	18.2%	135	16.5%	86	10.5%

Table 7

In my class, the students with better proficiency in English, are more familiar with work on computer.									
completely untrue		**partially incorrect**		**hesitant**		**partially true**		**completely true**	
171	20.9%	136	16.6%	192	23.5%	199	24.4%	114	14%

The example from the table No. 8 shows the students` assessments of teaching communication in relation "teacher–student".

Table 8

The teacher of computer science often uses words that I do not understand .									
completely untrue		**partially incorrect**		**hesitant**		**partially true**		**completely true**	
300	36.7%	185	22.6%	182	22.3%	91	11.1%	55	6.7%

The examples from the tables No. 9 and No. 10 are the results of students' perceptions of computer science textbooks. Wider survey showed that a very small number of students use their personal textbooks and expert literature in the school library:

Table 9

Computer science textbook are incomprehensible and they are not helpful for learning.									
completely untrue		**partially incorrect**		**hesitant**		**partially true**		**completely true**	
78	9.5%	108	13.2%	276	33.8 %	168	20.6%	184	22.5%

Table 10

It often happens that I do not understand some words in computer science textbook.									
completely untrue		**partially incorrect**		**hesitant**		**partially true**		**completely true**	
255	31.2%	50	6.1%	110	13.5%	71	8.7%	327	40%

3. Correlations among the barriers in teaching computer science and among other variables in the study

Interconnection of questionnaire`s factors for measuring the barriers in teaching computer science, and their relations with other research variables, was checked in two ways. Firstly, we checked the statistical significance of linear correlation (Pearson`s coefficient) among the observed variables, and then, we conducted multiple regression analyzes in which the criterion variable was the score of the course of computer science.

Based on the obtained results, we saw that the variable *sex* was correlated with language barriers, which in this case means that these barriers were more expressed by females, while the correlation with socioeconomic and psychological variables had negative connotations, which in this case mean that these barriers were more expressed by men. All correlations have low intensity. The assumption is that the female sex is more uncomfortable because of language barriers in communication, and that the male sex is more uncomfortable due to socioeconomic barriers.

The Rating of computer science was significantly associated with the technical and ergonomic, educational (didactic and methodological) and language barriers, all correlations have negative connotations, which means that, as the growth of the barriers increase, the evaluation of this subject by all respondents will be increasingly lower; all correlations have moderate or medium intensity .

The variable *place of residence* was also significantly associated with the dependent variables which have low intensity and negative connotations. This means that respondents who live in villages show more prominent technical, ergonomic, language and socioeconomic barriers.

The employment status of mothers is significantly associated with socioeconomic barriers, thus, the lower the income of mothers, the more prominent barriers occur. We assume that if the mother is employed and has a regular income, the child`s living conditions are better and that`s why the child has better computer.

The financial situation of the family is also related to barriers in teaching computer science, thus, the respondents with better financial situation, have more prominent technical and ergonomic barriers (they are probably not used to working on outdated computers, as it is

the case with computers at school) while the decline in financial status of respondents causes the growing of socioeconomic barriers

Depending on the fact whether *the respondent has a computer at home* there will be technical, ergonomic, pedagogical and language barriers in the classroom, thus, if the respondents do not have computers at home, the growth of these barriers is recorded.

Depending on *what grade the respondent was in* when he got the computer, the resulting correlation has positive connotation, which means that the respondents who were given computers later (in high school), have more prominent technical-ergonomic and language barriers.

Based on self-evaluation of the respondents, *what do they do and like most about working with computer*, from all above-mentioned activities, only learning with computer showed a statistically significant correlation with the barriers to teaching computer science, thus, when the respondent spends more time learning with computers, he/she has lower educational barriers, and the language barriers in the classroom are reduced.

Depending on the assessments of the respondents *whether they need additional education*, if they think that they need it, their educational and language barriers are more prominent.

The level of knowledge after graduation from high school is statistically, significantly correlated with educational and language barriers, the correlations have moderate intensity and negative connotations, which means that the respondents who rated their knowledge better after high school, estimated that they had less pedagogical and language barriers in the classroom.

The level of knowledge after completing primary school is statistically correlated with language barriers. The correlation has a low intensity and a negative connotation, which means that the respondents, who rated their knowledge better after elementary school, estimated that they had less language barriers in the classroom.

When it comes to interconnection among barriers in teaching computer science, we concluded that, despite their presence, the correlations didn`t have high intensity. With increasing technical and ergonomic barriers an increase in pedagogical and psychological barriers is recorded. With the rise of pedagogical (didactic and methodological) barriers, in addition to the aforementioned technical and ergonomic barriers, the growth of language barriers in the classroom is obvious. Interestingly, the socioeconomic barriers do not show a statistically significant correlation with other barriers in teaching computer science. The assumption is that the family recognized a high importance of computer education for the future of the child and that computers have become mandatory equipments in homes.

Conclusions:

In order to improve IT education, we examined the teaching of computer science in gymnasium education. We have analyzed IT education from several aspects: chronological and developmental aspects, from the aspect of the barriers detected in several forms of organization of teaching and learning with the help of information and communication technology in foreign countries and from our own experiences. From our point of view, detected barriers in IT education were a starting point for finding barriers in teaching computer science in gymnasium education. We analyzed the correlation between barriers in high school and barriers in primary school. We felt that the appreciation of the views of the most important participants in education, certainly led to its higher quality: teaching computer science in gymnasium education was by assessed gymnasium students, computer science teachers and by students who had completed gymnasium.

Finally, we have in mind Umberto Eco`s question whether the desire that all cultural phenomena are viewed as communication phenomena is rational or it presents intellectual idleness. We believe that any study of communication teaching that is aimed at removing ambiguities and barriers is important for the process of learning. By reducing language barriers, it is possible to minimize other barriers detected in teaching computer science. The conclusions reached on the basis of research results, as well as educational measures of corrections can be applied to other educational courses.

References:

Berge, Z. L. (2004). Barriers to Online Teaching in Post-Secondary Institutions. Online *Journal of Distance Education Administration*, Retrieved from URL http://www.westga.edu/~distance/Berge12.html

Berge, Z. L. (2006) Barriers of Students in the Effective Use of Information Technology in Education. *Journal of Educational Computing,* 26 (3), pp.415-426.

Berge, Z. L., Muilenburg, LY., & Haneghan, JV. (2002). Barriers to Distance Education and Training: Survey results. The Quarterly Review of Distance Education, 3 (4), 409-418.

Bojanić, Ž. (2010). *Fundamentals of Communication. Business Communication Skills.* Novi Sad: USEE – Southeastern European Union Faculty, the Faculty of Law and Business Studies, Prometej.

Eco, U. (1973). *Culture of Information and Communication*. Belgrade: Nolit.

Janicijevic, J. (2000). *Communication and Culture: with an Introduction to the Semiotic Research*. Novi Sad: Library Theoria, Sremski Karlovci, Publishing House of Zoran Stojanovic.

Krneta, Lj. (2009). Students` Barriers to Teaching Informatics and Computer Science. In: International Scientific Conference in Bulgaria, Trivani, on education (227-233). Comparative Educational Society and Sofia University, BCES 7.

Krneta, Lj. (2009). Barriers in Teaching the Course – The Use of Computer Science in Construction Work and Impedimental Factors that Inhibit the Efficiency in Auto CAD. In: Technology, Information and Education for Learning and Knowledge Society, FTN, TIO-05 Novi Sad.

Krneta, Lj., Glušac, D. (2011). Compulsory Computer Science Education in Primary School – a Prerequisite for High – Quality IT Education in High School. *Pedagogical Reality,* No. 8-9, The Union of Pedagogical Societies of Vojvodina, Novi Sad.

Krneta, Lj. (2012). *Barriers to Teaching Computer Science in Gymnasium Education and the Possibilities of Their Reduction* (Doctoral Dissertation), Technical Faculty "Mihajlo Pupin" Zrenjanin, Serbia.

Milutinovic, J. (2005). The Aims of Education and the Concept of the Curriculum. *Pedagogical Reality,* No. 9-10, The Union of Pedagogical Societies of Vojvodina, Novi Sad (pp. 694-704).