

**INNOVATIVE INFOTECHNOLOGIES  
FOR SCIENCE, BUSINESS AND EDUCATION  
Vol. 1(8) 2010**

# CONTENTS

## Section: Education

3-7

M. Kumar Agarwal

INTERNET-BASED LANGUAGE  
LEARNING AND TEACHING



8-11

Violeta Jadzgevičienė, Algirdas Lančinskas

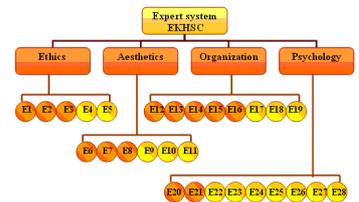
VISUAL ANALYSIS  
OF QUESTIONNAIRY DATA



12-16

Irena Kulisha, Ravil I. Muhamedyev,  
Alexander Mrochko, Abduhali N. Shynybekov

CORRELATION – REGRESSION ANALYSIS  
OF THE KNOWLEDGE AND SKILLS  
COMPLEX EXPERT SYSTEM



## INTERNET-BASED LANGUAGE LEARNING AND TEACHING

M. Kumar Agarwal <sup>a</sup>

Riga Business School, Riga Technical University  
Skolas St. 11, LV-1010, Riga, Latvia

*Received 27 December 2009, accepted 1 February 2010*

**Abstract.** This article explores teachers and students benefits of using Internet-based Language Learning (IBLL) which includes teaching English Language. This paper presents advantages and disadvantages of using internet resources and computers to learn and teach English language. Until quite recently, Internet-based Language Learning was a relevant topic mostly to those with a special interest in that area. Recently, though, the internet has become so widespread in educational institutions and homes and its uses have expanded so dramatically that the majority of English language teachers have started the implications of the internet for language learning. This article provides brief overview of how internet resources can be used for language teaching. It focuses not on a technical description of hardware and software but rather on pedagogical questions that teachers have considered in using internet resources in the classroom.

**Keywords:** Internet resources; Online quizzes; Language learning; Language teaching; IBLL.

**Short title:** Internet-based learning.

### Introduction

Nowadays *Internet-based Language Learning* (IBLL) is the most innovative area in the practice of English language teaching and learning. Keeping students interested and engaged in current topics or activities is a daily challenge for teachers in the classroom. One of the advantages of IBLL is that it provides new possibilities for assisting teachers to successfully meet this challenge.

In the last few years the number of teachers using IBLL has increased significantly. Although the potential of internet resources for educational use has not been fully explored yet and the average educational institutions still make limited use of computers and internet resources, it is obvious that we have entered new information age in which the links between technology and teaching of English as a Foreign Language have already been established. The development of the internet brought a revolution in the teachers' perspective, since teaching tools offered through the internet were gradually becoming more reliable [1]. Nowadays, the internet is gaining immense popularity in English language teaching and more and more educators and learners are embracing it.

Until recently a lot of research has been carried out on internet resources for language acquisition. Several authors have written various articles confirming the benefits of IBLL [2]. All the articles show how internet resources can be used and give their addresses but no author has ever explained how IBLL can be applied in a large class. The author of this article has tried to solve the problem of using IBLL in large class.

This article is structured as follows. The first section deals with the advantages and disadvantages of IBLL. The second section explains how computers can be used in class, learning the language. The third section shows the approaches of group division and finally, the last section presents the list of internet resources which can be used for English language acquisition.

### 1. Advantages and Disadvantages of IBLL

There are a lot of advantages and disadvantages of IBLL, but there are not so many disadvantages as there are advantages. There are a lot of challenges that teachers face while instructing classes because it is difficult to keep good discipline in class and teachers have to provide more students with different abilities who want

---

<sup>a</sup>Corresponding author, email: [kumarlatvia@yahoo.com](mailto:kumarlatvia@yahoo.com)

to learn the language at different speeds and in different ways [3].

### 1.1. Advantages of IBLL

The advantages of Internet-based language learning are as follows.

1. IBLL provides students with a lot of genuine educational materials.
2. IBLL can lead to autonomy, as learners control exercises regarding the learning process and little dependent on a teacher.
3. Computers present materials in various ways [3]. Electronic things on the screen are presented in a way that they become more attractive and less indelible than traditional methods of learning languages.
4. IBLL provides students with a possibility to use online references allowing them to consult electronic resources beyond those of grammar-check, dictionary and thesaurus.
5. Computers use various colors, types and sizes of letters.
6. IBLL allows distance education [4].
7. Computers present a text word by word, phrase by phrase, line by line, question by question, page by page, etc.
8. Computers can scroll lines of text up the screen, or change screens on demand or after a set time.
9. Computers free students from the limitations of traditional writing tools.
10. Computers transform learning languages from a traditional passive exercise to an interactive experience of discovery and exploration.
11. Computers are flexible and untiring. Computers 'do not get tired' and can repeat the same thing again and again without complaining.
12. Computers help language learners to create, analyze, and produce information and ideas in an easy and efficient way [5].
13. Computers give immediate feedback if they are programmed to do so.
14. Computers confirm if the answer is correct, give the correct answer or a hint if the answer is incorrect, etc, if they are programmed to do so.
15. Computers rapidly and accurately check answers, if they are programmed to do so.
16. Computers' clocks can be used to time the students' work, limit the amount of time allowed to read a passage or do an exercise or a set of exercises, etc.
17. Language learning can be individualized using computers. Students study materials are related to their individual goals and what they need or are interested in with the appropriate difficulty level and at their own pace [3].
18. With the help of the internet, teachers and students can work wherever and whenever it is needed not only in class at a fixed time and place.
19. Computers keep records accurately [2].
20. Computers help students realize their full potential and collaborate as a team to accomplish tasks more effectively.
21. Teachers keep track of individual or class scores and times [4].
22. Computers enable students to electronically monitor and control the language learning process.
23. Computers enable teachers to quickly retrieve students' electronic writings for future analyses and grading as teachers can

send assignments and notices electronically and monitor the progress of the student or the group.

24. Computers calculate quickly and accurately [2]. They help teachers to count total scores, averages, standard deviations and statistically analyze individual student and class results.
25. The internet gives an opportunity for shy students to have a forum for expressing themselves and asking questions.
26. IBLL offers students genuine educational programs, games, simulations, dictionaries, etc.
27. Using multi-media materials, computers display written texts and use sounds, still pictures, and videos. Students feel that things are more real and more easily understood.
28. The internet allows the teacher to quickly give all students certain information and to obtain information from the students quickly, too.

### 1.2. Disadvantages of IBLL

Besides having a lot of advantages of IBLL, there are several disadvantages. IBLL is not applied everywhere successfully because there are several barriers that do not let it be applied in the educational programs [2]. The barriers of IBLL can be classified in the following common categories.

1. Both students and teachers must be computer-literate because using IBLL means being good at computers in order for a user to give commands to a computer and respond to it [2].
2. Sometimes available internet resources are difficult to use despite the fact that a good manual is provided. No matter how simple computers and the internet are, students need to learn a lot in order to use them properly.
3. Internet resources have limitations regarding their memory, speed, methods of input and output, etc. Internet resources for language acquisition are still imperfect [5].
4. Processing information takes time.
5. Information is usually input by typing it in, so to use a computer efficiently, it is necessary to know how to type. Nowadays there are a few internet resources with voice recognition but they are not very popular for not being well-developed.
6. In general all internet sites do what they are programmed to do. All internet resources have some limitations. For example, some language learning resources show the final score after taking a quiz without any further explanation of mistakes.
7. Some internet resources may not be able to do exactly what a user wants them to do.
8. IBLL cannot handle user's unexpected requests and requirements as computers may perform the things they are designed to do.
9. Computers and access to the internet are expensive [5]. In addition, there is a great deal of additional equipment which is needed. Low budget educational institutions and low-income students usually cannot afford a computer.
10. A special classroom is also necessary, along with technicians to keep the computers and the network working properly [3].
11. Computers break down, and they may have technical problems [4].
12. It is also necessary to train teachers in order to make them ready to explain the things better and use Information Technologies [3].

## 2. How to Use a Computer in Class

Computers with internet resources can be used effectively in classrooms if teachers use the following structure of language learning.

1. Select computer materials that are going to be used i.e. a program or the internet resources.
2. Plan the lesson. Teachers can decide to use internet resources to explain topics or whether to take online quizzes. The plan of the lesson also depends on the following: the size of a class, student motivation and course learning objectives.
3. Make the computer class ready before lessons. This means loading the computer with the chosen material ahead of time.
4. Divide the class into several groups with at least one student who is good at computers and the language to be learned so that more experienced students can help the others.
5. Encourage students to use several online resources for the topic given and take quizzes.
6. If there is not enough of online resources or if students do not understand the topic, a teacher should be always around to explain it using the classical approach.
7. Make students take at least one quiz on each language learning part i.e. reading, writing, listening and conversation.
8. Ask students to submit their assignments electronically to your e-mail.

## 3. Need to use IBLL

Large classes are a big problem while teaching a language and keeping the discipline. Large class can be handled better dividing it into various groups. In order to divide a class into groups it is vital to consider the following factors: i) the size of a class; ii) intellectual maturity of students; iii) students motivation; iv) course learning objectives; v) instructor's preferences; vi) availability of technologies.

### 3.1. Different approaches

As soon as all the above-mentioned factors are defined, a class can be divided into groups using the following three well-known methods.

1. *Same-ability groups.* The students at the same levels can be grouped so that they will feel free working with others and teachers will not have to explain the things to each one personally. Such kinds of groups are really very good not only for teachers but also for students as the teacher can leave the groups of faster learners to get on with the work on their own. She can give extra help to individual learners in the slower groups. The teacher can just come around, give some instruction or tasks to do if the group is strong and give more time to the group consisting of students with lower level of the knowledge.
2. *Mixed-ability groups.* Such kind of groups can be organized in order to let the students at a higher level help the others. Learners with higher knowledge in the group can help others to master the work so that the teacher would not need teaching some parts. As the students work on their own, the teacher is free for other groups.
3. *Groups with leaders.* In same-ability groups and mixed-ability groups some students at a higher level can be appointed a leader

of the group so that they can help others to understand the things better and faster. Some teachers appoint faster gifted learners as group leaders or monitors who can help slower learners.

After a class has been divided into several groups, the following approaches can be applied in teaching a language: i) classical approach (*Teacher + Students*); ii) ultramodern approach (*Computer + Student*); iii) modern approach (*Teacher + Computer + Student*).

The research carried out at Information Systems Management Institute, Riga, Latvia and Riga Business School RTU, Riga, Latvia has proved that the best way of learning English language is the 3rd approach (modern) as having been explained the topic by the teacher and a computer in class, students learned better and faster and they scored better marks in the tests. Within the research the teacher divided class into several groups depending on the score that showed their level of English language knowledge. The test consisted of 63 questions. The teacher divided class into several groups taking into consideration that in one group there were not more than 5 students. The class was divided into several groups, the topic was explained to half of the groups by the teacher and the internet and the students took online quizzes and for the rest of the groups the topic was explained only by the teacher and the students took the quizzes in paper. To our surprise the students who had taken the quizzes online scored much higher and faster. Having carried out the above-mentioned research, we have come to the following conclusion of students' benefit using IBLL.

### 3.2. Students' benefit using IBLL

1. Within IBLL students work with great pleasure on the computers as the language is given in different and more interesting, attractive ways through games, animated graphics and problem-solving techniques [1].
2. Students are well-disciplined as the use of technology inside or outside the classroom tends to make the class more interesting.
3. Students feel empowered and less afraid to contact others and realize their full potential as a team to accomplish their language acquisition tasks more effectively.
4. Students instead of a teacher become leaders in class
5. Students receive feedback immediately and they benefit from it.
6. Some online quizzes explain students' mistakes, which make students understand the topic faster [2].
7. Students are highly-motivated to use IBLL because they associate it with fun and games or fashion.
8. Students have time flexibility as they can use various resources of authentic materials either at school or from their home. They do not need to be at a fixed place at a fixed time to learn a language or to pass a test.
9. Students feel independent from a single source of information as the internet provides them with thousands of information sources. For one particular aspect of any language there can be found a lot of different internet resources.
10. Students get greater interactions [4].
11. Students do exercises and learn faster with several windows open at a time and it helps them to better understand any language aspects explained by different instructors.



Fig. 1. Screenshot of web-site.

E-mailing among teachers and students or students and students make language teaching and learning job well-organized as teachers can keep all materials received in various folders in a proper way. It makes students feel closer to his/her language instructor which is the most important step towards a positive result.

#### 4. Internet resources for the English language learning

The following sections will serve to give the endless source of material for teaching and learning the English language. I have created my own web-site [6] for IBLL with several links to test the knowledge of the English language on various aspects. Fig. 1 shows the screenshot of my web-site. This web-site provides English language learners with various internet resources. The language learning materials for all levels of learners' knowledge is included. By clicking on links learners can not only take different tests on various aspects of the English language with instant scoring but also can get the explanations. It also includes several useful internet resources as online dictionaries, games, a chat site, quizzes for defining the level of English language knowledge etc. It also provides a standardized format for a letter of application and CV writing.

##### 4.1. Internet resources for grammar teaching and learning

Below is a list of the most common online grammar resources: the grammar guide for advanced users [7]; advanced English lessons [8]; English grammar online [9]; online English grammar [10]; study English today [11]; English grammar lessons [12].

##### 4.2. Internet resources for online quizzes

Below is a list of the most commonly used online quizzes: English grammar quizzes [13]; grammar quizzes [14]; ESL grammar quizzes [15]; practice on points of English grammar [16]; nonstop English [17]; English grammar [18]; English grammar exercises [19]; English lessons and tests [20].

##### 4.3. Internet resources for conversations

Below is a list of online resources for communication: ESL conversation online [21]; English daily [22]; practical American English audio course [23].

##### 4.4. Internet resources for dictionaries and encyclopedias

Below is a list of the most common online dictionaries and encyclopedias: the Oxford Dictionary online [24]; Cambridge dictionaries online [25]; Merriam-Webster dictionary and thesaurus [26]; Lingvo online [27]; Encyclopedia Britannica [28].

##### 4.5. Internet resources for newspapers

Below is a list of the most common online newspapers: Times online [29]; The New York Times [30]; Financial Times [31].

#### Conclusion

To conclude, the purpose of this article was to discuss the advantages and disadvantages of IBLL. There is no doubt that the availability of modern internet resources provides not only students but also teachers with exciting possibilities for innovative challenges in the teaching and learning of the English language. The conventional classroom-based instruction does not provide students with diverse knowledge because of the lack of authentic materials and time but at the same time IBLL can solve all these problems.

My own experience shows that students work better and more efficiently when there is something connected with the modern technologies in the classroom. In order to make students understand their teachers and actively take part in class activities IBLL is vital. By the way, the internet with its unlimited resources, will never replace language teachers, but it can make the English language teaching more interesting and fruitful for both teachers and students.

## References

1. Agarwal M.K. CALL - Advantages and Disadvantages. RTU scientific proceedings, Riga, Latvia (2008).
2. Agarwal M.K. Teaching large classes with web technologies // *Innovative infotechnologies for science, business and education*, ISSN 2029-1035 - Vol. 1(2) 2008 – Pp. 7.1-7.6.
3. Agarwal M.K. Models of Language learning and teaching with internet resources // *ISMA scientific proceedings*, Riga, Latvia (2009).
4. Wikipedia - the free encyclopedia [[http://en.wikipedia.org/wiki/Computer-assisted\\_language\\_learning](http://en.wikipedia.org/wiki/Computer-assisted_language_learning)], retrieved 2009 12 22.
5. Computer-assisted language learning [<http://www.edvista.com/ claire/call.html>], retrieved 2009 12 22.
6. Personal webpage [[www.englishtests.webs.com](http://www.englishtests.webs.com)], retrieved 2010 08 16.
7. The grammar guide for advanced users [<http://www.world-english.org/grammar.htm>], retrieved 2009 12 22.
8. Advanced English lessons [<http://www.englishpage.com>], retrieved 2009 12 22.
9. English grammar online [<http://www.ego4u.com>], retrieved 2009 12 22.
10. Online English grammar [<http://www.english4today.com>], retrieved 2009 12 22.
11. Study English today [<http://www.studyenglishtoday.net>], retrieved 2009 12 22.
12. English grammar lessons [<http://www.english-grammar-lessons.com>], retrieved 2009 12 22.
13. English grammar quizzes [<http://a4esl.org/q/j>], retrieved 2009 12 22.
14. Grammar quizzes [<http://esl.about.com>], retrieved 2009 12 22.
15. ESL grammar quizzes [<http://www.usingenglish.com/quizzes>], retrieved 2009 12 22.
16. Practice on points of English grammar [<http://www.grammar-quizzes.com>], retrieved 2009 12 22.
17. Nonstop English [<http://www.nonstopenglish.com>], retrieved 2009 12 22.
18. English grammar [<http://www.englishclub.com/grammar>], retrieved 2009 12 22.
19. English grammar exercises [<http://www.english-test.net>], retrieved 2009 12 22.
20. English lessons and tests [<http://www.englishlearner.com>], retrieved 2009 12 22.
21. ESL conversation online [<http://www.focusenglish.com>], retrieved 2009 12 22.
22. English daily [<http://www.englishdaily626.com>], retrieved 2009 12 22.
23. Practical American English audio course [<http://www.1-language.com>], retrieved 2009 12 22.
24. The Oxford Dictionary online [<http://www.oed.com>], retrieved 2009 12 22.
25. Cambridge dictionaries online [<http://dictionary.cambridge.org>], retrieved 2009 12 22.
26. Merriam-Webster dictionary and thesaurus [<http://www.merriam-webster.com>], retrieved 2009 12 22.
27. Lingvo online [<http://www.lingvo.ru>], retrieved 2009 12 22.
28. Encyclopaedia Britannica [<http://www.britannica.com>], retrieved 2009 12 22.
29. Times online [<http://www.timesonline.co.uk>], retrieved 2009 12 22.
30. The New York Times [<http://www.nytimes.com>], retrieved 2009 12 22.
31. Financial Times [<http://www.ft.com>], retrieved 2009 12 22.

## VISUAL ANALYSIS OF QUESTIONNAIRY DATA

Violeta Jadzgevičienė<sup>a</sup>, Algirdas Lančinskas

Vilnius Pedagogical University, Studentų str. 39, Vilnius, Lithuania

*Received 24 November 2009, accepted 10 March 2010*

**Abstract.** Nowadays surveys play an important role in modern society. They are needed in many fields of society: to inform the government, politicians, businessmen, scientists, media and citizens. A lot of information is collected in every survey which one later needs to process and give results of the research. A short review of questionnaire research, data presentation in a form of a diagram, widely usable data analysis software and data visualization with *Borland Delphi 7* component *Charts* are going to be presented in this paper. In order to create a visual analysis of questionnaires' results a user-friendly application was designed; also, more advanced steps of the task realization are described.

**Keywords:** Questionnaire research; Charts in Borland Delphi; Arrays of objects.

**Short title:** Research results analysis.

### Introduction

Questionnaires are one of the most popular methods of public research. They enable to gather information from target population in a convenient way. There are two ways to complete a questionnaire. First, respondents could be asked to complete a questionnaire without researcher being present. This is a postal questionnaire. Second, respondents could be asked to complete a questionnaire verbally with the presence of the researcher. This variation is called as *structured interview*. All that process of collecting and analyzing data collecting is called questionnaire research. Every method has advantages and disadvantages which appear in certain situations of a research. It is not difficult to analyze Questionnaires and most statistical analysis software can process them easily.

Most popular statistical programs are: STATISTICA [1], STATGRAPHICS [2], SPSS [3], SAS [4]. Purpose and functions of these programs packages are similar. Using this statistical software, statistical results can be received in various forms. However, they require higher skills of using computers and basic knowledge of statistics. Therefore, it was decided to create a simple and user-friendly application designed for the visual analysis of a small-sized questionnaires' research, user manual is also created.

This work is aimed at processing and getting visual analysis

of small-sized questionnaires' research as they are carried out in schools, offices, etc.

### 1. Programming tools

The program is created on *Microsoft Windows XP* operating system using *Borland Delphi 7.0* programming environment with standard libraries [5]. Delphi component *TChart* was used for diagram charting. The program is compatible with any version of *Microsoft Windows*.

### 2. Program structure

Fig. 1 represents the structure of program. All of these operations are explained below.

#### 2.1. The main window of the program

The main page of the program (Fig. 2) is built from operation zone (menu), chart of the results from questionnaires, status zone (at the bottom of the window) and the object *ListBox* which is invisible for the consumer. The main commands of the status zone are presented as follows:

<sup>a</sup>Corresponding author, email: [violeta.jadzg@gmail.com](mailto:violeta.jadzg@gmail.com)

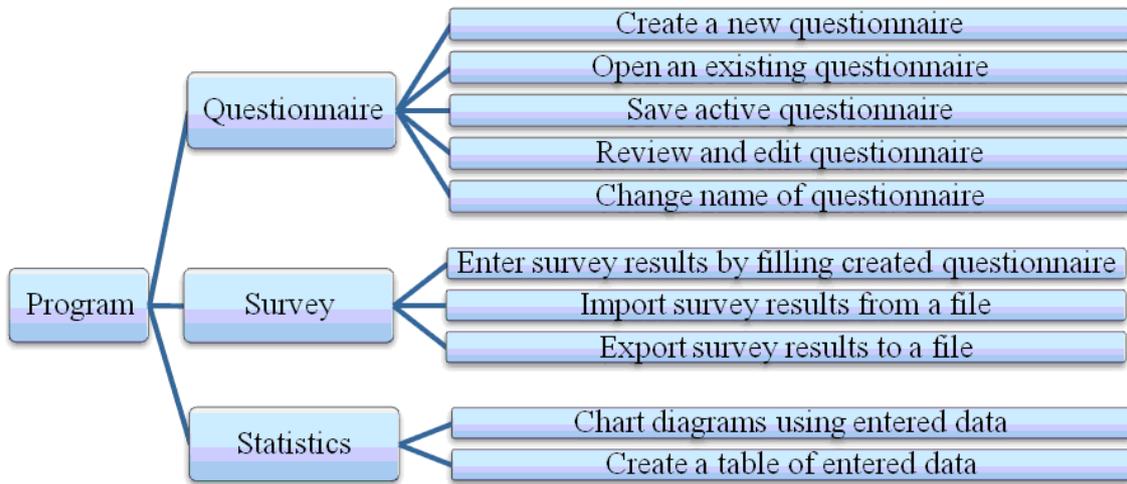


Fig. 1. The structure of program

- i) the description of the new questionnaire;
- ii) the bootstrap of the questionnaire set which was created earlier (from the file);
- iii) the saving in the file of the described questionnaire set;
- iv) the review and drafting of the described questionnaire set;
- v) the emendation of the title of the questionnaire;
- vi) the establishment of the information which was collected during the questionnaire by filling them;
- vii) the bootstrap of the questionnaire results (from the file);
- viii) the saving of the questionnaire results;
- ix) the composition of diagram rates;
- x) the composition of chart rates;
- xi) the instruction of programs' consumption.

The chart of the questionnaire results is built on the basis of the object *StringGrid*. It is filled in automatically. The columns of the chart are built according the user request: user must select the several numbered positions. Numbers are related to the answer variant and the lines of the chart are filled by the numbers of the questionnaire questions. The last column of the chart („Neatsakyta“/Unanswered) is filled with a number of unanswe-

red answers to a certain question.

The invisible object *ListBox* (in the program code the title is „laikinas“/temporary) is used as an array of *String* type element. While creating or loading a set to this program the questionnaire results are being written into it which is later used in a working process of the program.

## 2.2. The creation and the saving of the questionnaire

At the beginning of program's work, the function of the establishment of the questionnaire results is inactive. If one wants to activate it, the description of the questionnaire according to which the data will be established has to be written, one has to write a set – to indicate the title of the questionnaire, the formulation of each question, the variants of the elective answers and question to answer format (whether you can choose only one answer or more). In order to make this procedure the program gives a window of the establishment of a questionnaire set (Fig. 3) where the information mentioned above can be indicated.

	Var. 1	Var. 2	Var. 3	Var. 4	Var. 5	Var. 6	Var. 7	Var. 8	Neatsakyta
Kl. 1	14	10	15	5	6	0	0	0	10
Kl. 2	10	15	10	13	0	0	0	0	10
Kl. 3	17	17	6	0	0	0	0	0	10
Kl. 4	5	5	4	8	8	4	6	0	10
Kl. 5	7	8	7	8	3	8	0	0	9
Kl. 6	18	25	0	0	0	0	0	0	7
Kl. 7	7	6	8	5	6	3	6	5	4
Kl. 8	4	14	4	6	10	2	0	0	10

Fig. 2. The main program window

Fig. 3. Window of the establishment of a questionnaire set

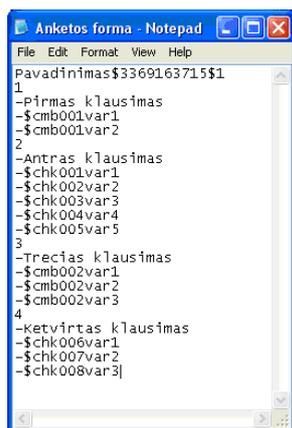


Fig. 4. An example of a questionnaire set saving file

After that, the data which was written during the process of the description of the questionnaire set is being transferred to object ListBox and later it can be saved in the questionnaire set file which was indicated by the consumer with an extension „ank“. There is a certain order for writing the data to a file or to the object ListBox which makes reading of the data easier. The example of a questionnaire set is represented in Fig. 4. The first line of the file is made from the title of the questionnaire, questionnaire set id and the mark of a possible edit ("0" – questionnaire set was not edited, "1" – questionnaire set was edited). The further content of the file is built up from blocks which describe each question of the questionnaire. Each block is made from the number of the question, formulation of the question and possible variants of the answers. Before the formulation of the question the symbol „–“ is marked. Before each variant of the answer the combination of symbols „-\$“ is marked then the mark „cmb“ is written which means that only one answer variant is possible, or the mark „chk“ is written which means that there may be more than one answer variant. Then the line number of an object which will be created in the process of making questionnaire set review window is indicated. At the end of the line the answer variant formulation is written.

### 2.3. Review and edit of the questionnaire set

You can review your saved questionnaire set and edit it if it is needed: add a question, change the question formulation, eliminate unwanted questions or change the succession of the questions in the questionnaire. The button zone at the top of the questionnaire review window allows editing operation (Fig. 5).

It can be edited until the first questionnaire is filled. After that, all the possibilities of questionnaire set editing are turned off.

### 2.4. Filling and data saving of the questionnaire

When the questionnaire set is properly prepared one can begin the establishment of the data collected during the questionnaire – filling of electronic questionnaires. The consumer is presented

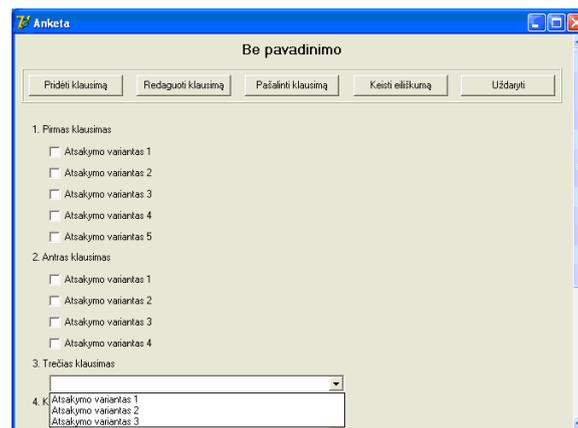


Fig. 5. Reviewing and editing questionnaire set window

with a questionnaire review window (Fig. 5) only in this case the edit line is hidden and instead the button „Įsaugoti“/Save appears which has a function of saving the data and getting another questionnaire. Also a number of filled questionnaires is added to the questionnaire title. After filling the questionnaire the button of saving is pressed. The data is written to array and the questionnaire set is being prepared for the establishment of new data.

The answers of one questionnaire questions are saved in double matrix. The first element in each line is the number of a question and the other numbers are the numbers of the answers to the question. From all of the questionnaire data matrixes, the matrix array is made up (triple matrix). The whole triple matrix is saved in the file (\*.ats) by a column down after printing all the double matrixes.

The saved data of the questionnaire can be loaded to the program repeatedly. While doing this command the data saving matrix is being filled by the data of a chosen file. Before loading the data the program checks if the identification numbers of the questionnaire set and chosen data file can be synchronized in order to avoid inconsistencies of data file and questionnaire set. If there is any inadequacy the consumer will be warned about the mistake. The data will not be loaded if the questionnaire set is closed.

## 3. Depiction of the results

The results of the questionnaire can be delivered visually – according to the data the diagrams are drawn (Fig. 6). The consumer can choose if the diagram will be drawn according to one question of the questionnaire or according to two – cross diagram of two questions. The consumer is offered to choose one of these diagram types: circle, column or linear diagram.

At the top of the window the main diagram parameters are shown (they are used when the diagram is drawn that is why they are used only after the drawing of repeated diagram): i) the question is chosen to which the diagram will be drawn; ii) the type of diagram is chosen; iii) the indication whether the diagram is for one question or for two is made; iv) the data aspect is chosen (unitary or percentage).

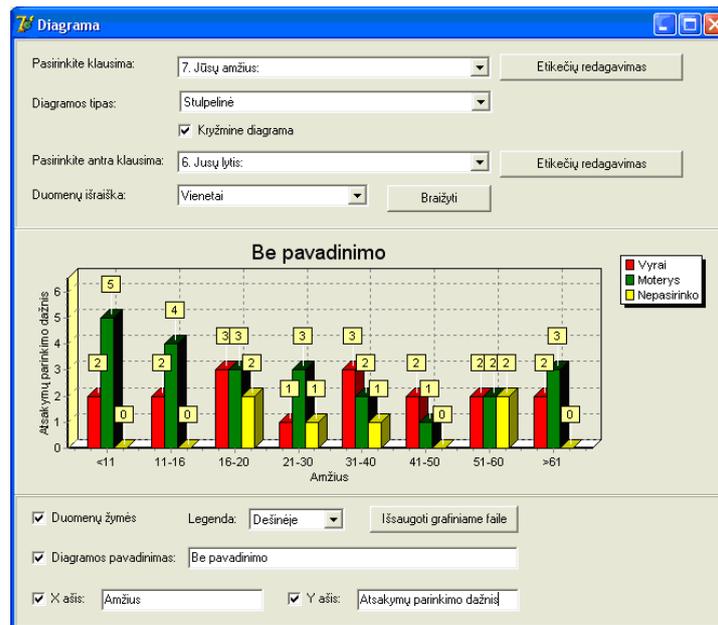


Fig. 6. Charting window

At the bottom of the window supplementary diagram settings are shown: i) it is chosen if data marks which are above diagram columns will be visible or not; ii) the legend place in the diagram window is chosen (on the right, on the left, at the top, at the bottom or invisible); iii) the title of the diagram is indicated; iv) the titles of horizontal and vertical diagram axes are indicated.

The created diagram can be saved in a graphic file (\*.bmp) which the consumer indicates himself. The diagram is drawn by pressing a button „Braižyti/Draw“. According to the button „Kryžminė diagrama/cross diagram“ (whether it is on or off) the procedure of one question diagram drawing or cross diagram dra-

wing is prosecuted. In both cases the diagram is drawn with the help of the *TChart* component.

## Conclusions

User-friendly application was designed in order to make a visual analysis of questionnaires' results. Arrays of objects are convenient tools for creating data mining application when the amount of the data is undefined. *TChart* as the component of *Delphi* programming environment is a useful tool to chart the results of questionnaire research in various types of graphical presentations.

## References

1. [http://www.statsoft.com/unique-features/statistica-features-benefits], retrieved 2009 11 03.
2. [http://www.statgraphics.com/product\_overview.htm], retrieved 2009 11 03.
3. [http://www.spss.com/software/statistics/], retrieved 2009 11 03.
4. [http://www.sas.com/technologies/analytics/statistics/stat/index.html], retrieved 2009 11 03.
5. See textbooks of *Turbo Pascal* and *Delphi*. For lithuanian readers - Dzemyda G., Stankevičius J., Šaltenis V. Programavimas Paskaliu: Turbo Paskalis ir Delphi. – Vilnius: Piktetas, 2000.

## CORRELATION – REGRESSION ANALYSIS OF THE KNOWLEDGE AND SKILLS COMPLEX EXPERT SYSTEM

Irena Kulisha<sup>1 a</sup>, Ravil I. Muhamedyev<sup>2</sup>, Alexander Mrochko<sup>2</sup>, Abduhali N. Shynybekov<sup>3</sup>

<sup>1</sup>Latvian University of Agriculture, J. Čakstes 5, Jelgava, LV- 3001, Latvia

<sup>2</sup>Information Systems Institute, Lomonosova 1, Riga, LV-1019, Latvia

<sup>3</sup>Kazakhstan National Agrarian University, Almaty, Kazakhstan

*Received 3 March 2009, accepted 4 April 2010*

**Abstract.** In order to define development indicators of future HM service culture, the complex experts' system (CES) named *Evaluation of Hospitality Service Competence* ("EHSC") v 2.0 created by one of the authors based on software "Mini Experts' System" was applied. The program operates as a cover of a simple ES based on Bayesian system of conclusions. The experimental diagnostics detected few faults in question formulations of "0 - EHSC". This resulted in the effects not being credible. During the experimental probation of CES "EHSC" the following was ascertained: the diagnostics process of students turned out to be labor and time-consuming (up to 3 hours); students did not understand some of ES questions because of the incorrect formulation. Due to this the authors made a decision to optimize CES "0 - EHSC" performing a correlation - regression analysis, by reducing the ES number and correcting the questions. After the optimization the CES "EHSC" was developed CES "1 - EHSC". The significant number of questions increases the time of knowledge evaluation (about 3 hours). Correlation analysis methods were used to reduce the number of expert systems. The number of expert systems was reduced to 20 and overall time of testing decreased to 1,5 hour.

**Keywords:** Diagnostics, expert system, correlation – regression analysis.

**Short title:** Correlation - regression analysis

### Introduction

A situation analysis of today's education allows one to state that one of the main problems of pedagogic diagnostics is the lack of diagnosing "set of instruments", which enables: i) to define peculiarities of a students' acquirement of knowledge, abilities and skills in different study subjects; ii) to determine the characteristics of student's difficulties and reasons of their emergence; iii) to assess the changes taking place in students' development.

In order to perform diagnostics of future hospitality managers' development of HM service competence, the author offers the application of the diagnosing method - *Expert System* (ES) as a modern and contemporary method of research.

### 1. Idea of Expert System (ES)

Intellectual systems and technologies, expert systems and artificial intellects are a leading and perspective direction of the development of the 21st century, opening new possibilities in optimization of various processes, optimal control, compliance control, testing and other processes of intellectual knowledge acquirement, applying the achievements of information technologies [1]. Expert system – a programmable system, combines the abilities of a computer and man – expert's experience and knowledge. Expert system can offer a reasonable council or find a reasonable decision to the formulated task [2]. ES are applied systems of artificial intellect, in which the knowledge base is formalized empiric knowledge of highly qualified specialists (experts) within a confined area of study subjects.

---

<sup>a</sup>Corresponding author, email: irena.kulish@inbox.lv

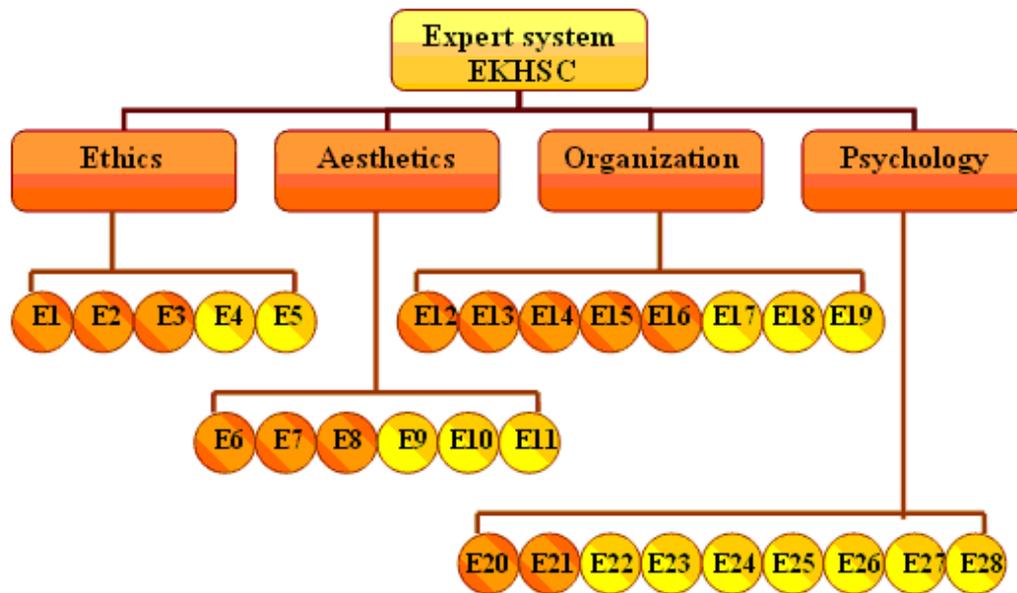


Fig. 1. The structural scheme of the complex experts' system "EHSC" for competency assessment in service culture.

Bielawski and Lewand explain this term like this: "Experts' systems are computer programs, in which for the modeling of human-expert activity within a narrow area of knowledge, the knowledge and experience is applied" [3].

One of the approaches is the application of ES in the study process, which in action is based on the application of the uncertain logics [4]. Application of uncertain logics helps to complete tasks successfully when their output data is formalized weakly. Service culture in a hospitality field is such a field of human activity, where it is difficult to formalize the knowledge of managers.

In order to define development indicators of future HM service culture, the *complex experts' system* (CES) titled *Evaluation of Hospitality Service Competence* ("EHSC") v 2.0 [5,6] was created by the author. This system is based on software "Small Experts' System" was applied [7]. The program operates as a cover of a simple ES, based on Bayesian system of conclusions [8].

The structure of CES "EHSC" is showed in Fig. 1. The system is formed of 28 local experts' systems, depicted in circles; they are divided into four groups. Each group assesses one aspect of service culture: ethical, aesthetic, organizational, psychological. The colored circles are applied to technological culture, while the uncolored - to humanitarian culture.

The diagnostics of future HM service competence's development are carried out based on the answers given to 374 questions, covering the most significant criteria of managers' service culture to the maximum. Formulated questions consider the specifics of activities within the hospitality field.

The program operates as a cover of a simple ES, based on Bayesian system of conclusions [8], which foresees that most of the time the information is not absolutely precise, it possesses the nature of probability. Therefore, after making a list of questions the expert determines the probability of a positive or negative assessment, the answers 'yes' or 'no', depending on the formulation of each question.

The same way the approximate probability is determined for each mentioned conclusion obtained as a result of the respective analysis. After processing the answers, obtained during the analysis of service culture's criteria (aesthetical, ethical, organization technological and psychological), the system of experts logically chooses one of the following levels (conclusions): level 1- high; level 2- average; level 3 – low.

The concluding stage of the CES formation is the experimental probation, which was carried out while the user (student) was working with the experts' system. The dialogue of the user and the system is formed in the format of questions and answers. The value scale of answer variants is from -5 to 5. According to the scale, the answer "-5" mean the answer "no", "0" – the student cannot formulate the answer clearly, "5" – the answer is "yes".

In order to try the test the CES "EHSC" author has performed an experimental diagnostics of respondents (testing No.0), applying CES "0 - EHSC", in Information System Management Institute (ISMI). During the process of diagnostics 33 first year students of ISMI who acquired knowledge in study programs "Manager of Tourism Business Activities" and "Hospitality Management" were involved.

The experimental diagnostics detected few faults in question formulations of "0 - EHSC".

1. Conclusions made by the system after processing the received answers, rather clearly define the situation in each of the reviewed structure components of the service competence. After processing the answers obtained by performing the analysis of future HM's service competence's structure components, ES logically chose one of the conclusions (high level, average level, low level).

2. During the probation no discontinuities were ascertained in the operation of the system. The feasibility of the system to determine a development level of students - the future HM service competence during the dialogue, confirmed the practical significance of CES "EHSC"'s application.

3. During the experimental probation of CES “EHSC” the following was ascertained: the diagnostics process of students turned out to be labor and time-consuming (up to 3 hours).
4. Students did not understand some of ES questions because of the incorrect formulation.

Due to this the author made a decision to optimize CES “0 - EHSC” performing a correlation – regression analysis, by reducing the ES number and correcting the questions.

## 2. Correlation - regression analysis

It is possible to optimize CES “EKHSC” by the number of local expert systems, determining the mutual connection of evaluations of these systems. All connections which can be expressed and measured in numbers can be defined as statistical, including the functional connections. A connection between two or more accidental quantities can be calculated applying a method of mathematical statistics - the analysis of correlations and regressions.

A correlation connection is the substantial case of statistic connection, when various significances of one variable quantity correspond with different average significances of another quantity. A correlation connection among the features can be caused by several reason.

1. Dependence of outcoming features (its variations) from the variation of the factor feature (cause-effect relationship); a case when it is logically clear which feature is the independent variable (factor)  $x$ , which – the dependent variable (result)  $y$ .
2. Interdependency of two results of a common cause.
3. Interconnection of features, where each is both the cause and the effect. The case when each feature can be both the dependent variable and the independent variable.

According to the essence of correlation connection, there are two tasks for its research: i) determination of the connection type and evaluation of the equation parameters, which displays the connection between the average quantities of the dependent variable and the quantities of the independent variable (regression analysis); ii) measurements of connection closeness of two or more features [5]. The first task is general and covers functional connections, but the second task is characteristic to statistical connections.

In order to determine the closeness of the connection several indicators are applied.

Firstly, it is the determination ratio  $R^2$  and the correlation relation  $\eta_{y,x}$ :

$$R^2 = \frac{\sum_{i=1}^n (\hat{y}_i - \bar{y})^2}{\sum_{i=1}^n (y_i - \bar{y})^2}, \quad (1)$$

where  $n$  – number of units in the set;  $\hat{y}_i$  individual quantity after equation of connection;  $\bar{y}$  – total average quantity of the resultative feature;  $y_i$  – total average quantity of the resultative feature:

$$\eta_{y,x} = \sqrt{R^2}. \quad (2)$$

The simplest system of correlation connection is the linear connection between two features. The increased attention paid to linear connection can be explained by the variation confinement of the variable quantity, as well as by the fact that in most

cases applying calculations to the non-linear forms of connection they transform into linear forms.

Secondly, the closeness of connection pairs' linear correlation can be determined by correlation relation  $\eta_{y,x}$ . Besides, in the linear form of connection equation another closeness indicator of interconnection is applied – correlation ratio  $r_{x,y}$ . This indicator is a ratio, which is expressed not as absolute measurement units of features, but as a specific weight of the quadratic mean deflections:

$$r_{x,y} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \sum_{i=1}^n (y_i - \bar{y})^2}}, \quad (3)$$

where  $n$  – number of units in the set;  $\bar{y} \cdot \bar{x}$  – common average quantities of the features;  $y_i \cdot x_i$  – individual quantities of the features.

The correlation ratio does not depend on the conventional measurement units of the features, thus it is comparable to any feature. Usually [6] a significantly close connection is considered in cases when  $r_{x,y} > 0.7$ ; average close –  $0.5 < r_{x,y} < 0.7$ ; weak close –  $r_{x,y} < 0.5$ .

Applying this method of correlation and regression analysis, one must consider that correlation indicators can be interpreted only within the terms of deflection variations from the average quantity (in space of differences) and the correlation of features should not be interpreted as the connection of its levels.

The indicators of correlation connections, determined by a limited set (size  $n$ ), actually are only evaluations of feature - selection of statistical connection. Therefore an assessment of the preciseness and extent of credibility of the correlation's parameters is required. With credibility one must understand a probability that the quantity of the parameter under testing will not be equal to zero. The credibility probability of correlation parameters is determined according to testing rules of statistical hypotheses developed by mathematic statistic, i.e. comparing the evaluation quantity with the mean random error of evaluation [5, 9].

The mean error of correlation ratio's  $r_{x,y}$  evaluation is calculated according to the following formula:

$$S_r = \frac{1 - r_{x,y}^2}{\sqrt{n - 2}}. \quad (4)$$

Knowing the mean error of the correlation ratio's evaluation,  $\gamma$  – can be calculated, the probability that the zero value of the ratio falls within the credibility interval, taking into consideration the errors of quantities (probation of correlation ratio's significance). In this connection the ratio is related to its mean error, i.e. Student's  $t$  – criterion:

$$t = \frac{r_{x,y} \sqrt{n - 2}}{1 - r_{x,y}^2}. \quad (5)$$

Critical quantity is determined by tables of Student's division, taking into account the condition that:

$$P = (|t| > t_{\gamma,k}) = r_{x,y}. \quad (6)$$

Fig. 2. Table of correlation ratios of local expert systems

In that case  $k=(n-2)$  – a figure of degrees of freedom;  $\gamma$  - level of significance.

For the local experts’ systems, whose  $r_{x,y}$  came near to value (1), the assessment credibility of the correlation ratio was examined (the value level was calculated).

$$r_{x,y} \rightarrow 1 \tag{7}$$

The values of Student’s criteria were calculated and for the level  $\gamma=0.95$  the value of correlation value was defined.

If the correlation ratio is close to one, then the division of its evaluation differs from the average or Student’s division, because it is limited by the quantity 1. In cases like this R. Fisher suggested to re-form evaluation of ratio’s credibility into a form which does not possess such a limit:

$$z = 0.5 \ln \frac{1 + r_{x,y}}{1 - r_{x,y}} \tag{8}$$

The mean error of quantity  $z$  is calculated by the formula:

$$S_z = \frac{1}{\sqrt{n-3}} \tag{9}$$

but the quantity of Student’s criteria is determined as:

$$t = \frac{z}{S_z} \tag{10}$$

In credibility examination of pair correlation’s parameter assessment one must consider that in cases of small selection fields only close connections can be determined precisely, but in cases of big sets the connections of weak closeness are also credibly determined.

### 3. Results of the complex expert system’s “EHSC”: correlation - regression analysis

The task of correlation analysis was to determine correlation dependence among separate local expert systems, in which 28 ser-

vice competences of future hospitality managers developed by the author were reflected upon.

Clarifying correlation dependence among various evaluations of competence, provided by different local expert systems, it can be assumed that such a dependency can be caused and it can exist due to dependence between two effects of a common cause.

In order to optimize the number of the local experts’ systems, 28 local experts’ systems were subjected to the correlation analysis. For each pair of the local experts’ system by selection in amount of 33 units (number of students) the pair correlation ratios were obtained  $r_{x,y}$  (Fig. 2). The calculations of correlation ratios were performed applying the package of *MS Excel* data analysis [10].

For local expert systems whose  $r_{x,y}$  came close to significance 1, the evaluation credibility of correlation ratio was examined (the level of significance was calculated). Significances of Student’s t-criterion were calculated according to formulas (8, 9, 10) and significance of correlation ratio was determined for the level (see Table 1).

The results of data correlation analysis enabled the optimization of CES “EKHSC. The number of ES was cut down to 20, but the number of questions - down to 190. After the optimization the CES “EKHSC” was developed in both Latvian and Russian and named CES “1 – EHSC”.

The initial testing at ISMI was conducted twice, at the beginning performing the testing with “0 - EHCS”, but after a week with “1 - EHCS” (optimized CES). Comparing the results of both testings, a conclusion can be made that the results of both testings’ differ only slightly (see Table 2). Thus, in further researches it would be rational to use the optimized ES- “1 - EHCS”.

The initial diagnostics, applying the complex expert system “1 - EHSC” was performed in the three education establishments. Firstly, in the Information System Management Institute (ISMI) in Riga (Latvia). Then the research was continued in: i) Klaipėda Business and Technology College (KBTC), Klaipėda (Lithuania), ii) College of Hotel Management (CHM), Belgrade (Serbia).

Table 1. Significance of correlation coefficient.  $\gamma=0.95$ ,  $k=31$ .

$x, y$	$r_{x,y}$	$t$	$t_{\gamma,k}$	Significance
3, 5	0.98	13.6	2.04	significant
7, 24	0.99	13.6	2.04	significant
8, 24	0.73	13.1	2.04	significant
17, 4	0.99	13.6	2.04	significant
19, 23	0.96	13.5	2.04	significant
20, 13	0.93	13.5	2.04	significant
26, 1	0.89	13.4	2.04	significant
28, 1	0.94	13.5	2.04	significant

The first testing was performed applying the developed CES "1 - EKHSC" after correlation and reduction. This analysis involved 124 first year students of ISMI, 22 first year students of KBTC and 43 first year students of CHM. In total 189 first year students were involved in this research.

A completion of full analysis took 1 hour 15 minutes for ISMI students, for KBTC students it took 1 hour 40 minutes, for CHM students – 1 hour 50 minutes.

Correlation analysis methods were used to reduce the number of expert systems. The number of expert systems was reduced to 20 and overall time of testing decreased to 1,5 hour.

## Conclusions

Based on previously mentioned researches, it can be concluded as follows.

1. In this work the system of Bayes' decision making was applied. Experts' system for assessing hospitality culture knowledge was developed - formed by 28 local subsystems, which assess the knowledge of becoming specialists in 4 areas. Testing of the system was performed, which approved a self-evident improvement of results depending on the training time.
2. After a correlation - regression analysis the number of expert systems lowered to 20. Testing time reduced to 1,5 hours.

Table 2. Comparison of diagnostic results ( $r_{x,y}$  distribution) before and after optimization of CES "0 - EHSC". Testing was provided at Information Systems Management Institute, Riga.

High level		Average level		Low level	
Before optimization	After optimization	Before optimization	After optimization	Before optimization	After optimization
testing with "0 - EHCS"	testing with "1 - EHCS"	testing with "0 - EHCS"	testing with "1 - EHCS"	testing with "0 - EHCS"	testing with "1 - EHCS"
0.77617	0.70197	0.64624	0.51330	0.16393	0.23050

## References

1. Bielawski, L., Lewand, R. (1991) Intelligent systems defined. In: Bielawski, L., Lewand, R. Intelligent Systems Design: Integrating Expert Systems, Hypermedia, and Database Technologies. New York ... [etc.] : John Wiley & Sons, p. 17-62.
2. Kulisha, I. Muhamedijev, R. (2009) Experts' System for Assessing Students' Knowledge in the Area of Hospitality Technology. "Computer Modeling and New Technologies". Rīga : TSI, Vol.13, No.2, 31-37 lpp.
3. Moskvins, G. (2008) Intelektuālās sistēmas un tehnoloģijas: mācību līdz. Jelgava : LLU, 5. lpp.
4. Rivža, P., Arhipova, I. (1995) Ievads ekspertu sistēmās: lekciju konspekts LLU studentiem. – Jelgava, 9 lpp.
5. Buchnin A. (2001) "Malaja ekspertnaja sistema" v2.0. [http://bukhnin.chat.ru/], retrieved 2008 12 15.
6. Eliseeva, I.I., Juzbashev M.M. (2006). Obshchaja teorija statistiki: uchebnik (in rus.) Ed. Eliseeva, I.I. 5th issue. - Moscow: Finansy i statistika - P. 327-349.
7. Kozlov A. Ju.; Shishov V. F. (2003) Paket analiza MS EXCEL v ekonomiko-statisticheskich raschetach (in rus.) Ed. Mchitarian V.C. - Moscow: ONITI-DANA - P. 117-126.
8. Pustynnikova I.I. (2001) Technologija ispolzovanija ekspertnych sistem dlja diagnostiki znaniy i umenij // Education Technology & Society, Nr.4(4), c. 80-82
9. Joseph F. Healey. Statistics: A Tool for Social Research // Amazon.com Product, ISBN 0534627943.
10. Chastnikov A. P., Belov D.L., Gavrilova T. A. (2003) Razrabotka ekspertnych sistem (in rus.) - Sanct-Peterburg: BCHB-Peterburg - P. 12-33.