

THE WAY OF STUDENTS' EFFICIENCY IMPROVEMENT IN KNOWLEDGE ACQUISITION AND TRANSFER KNOWLEDGE MODEL IN CLAROLINA CMS

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Case study

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Summary: In this work, throughout the research which was organized in one high school in Bosnia and Herzegovina, it will be shown the influence of exercises on the final result in the e-learning environment at the final test done by students. The research was conducted from the subject informatics in the I, II and III grade. The type of the questions were of multiple choices, addition and accession. The aim was to see how much influence these online exercises have on the final outcome which is demonstrated through the final informatics test done by students and which is done in a classical way in classroom after the finished teaching materials that were planned according to high school rules. In the research, it was taken account of making all preconditions available for easy experiment conducting with regard to technical securing preconditions for students access to blended system of teaching. Concerning the recent experience, it is noticeable that youth like the use of IT and communication devices. In order to secure all necessary conditions, it was conducted the survey among students about having technical preconditions of online access to testing and about students knowledge of work principle in the Claroline LMS platform. The aim was to increase motivation of high school students with regard to the use of online materials, because in high schools of Bosnia and Herzegovina almost nothing is undertaken when it comes to the implementation of new IKT possibilities.

Key words: knowledge transfer, blended learning, Claroline, e-learning, exercises, motivation and web technology

INTRODUCTION

At informatics teaching, usually it is used computers for practical realization of curriculum depending on school having informatics cabinets. Curriculums are obsolete and don't follow changes that happen in achievements regarding information and communication technologies. Because of the actual situation, there is no unique education system and patchwork prevails, as teachers are left to themselves and they create teaching process according to their discretion.

The work's goal is to find and prove the needs for implementation of new achievements in gaining and acquiring knowledge by students in informatics teaching, especially by those who are under average level. It is a word about students who follow teach-

ing process slower, but also about those who want to learn more. Today, it is necessary to develop students' conscious about the need for continuing practicing for the purpose of achieving results that are necessary in order to prepare students for the use of gained knowledge. So when it comes to this, after finishing school, different methods are used in order to motivate students.

According students' conscious, there is not enough interest with regarding learning something new and achieving exceptional results which will help in creating life way, especially when it is a word about newer types of knowledge in the subject informatics.

Because of that, we want to explore in this work how and in which way the exercises created in the Claroline LMS platform have influence on the final outcome concerning the results which students show at the final test. The aim is to show in which way we can affect students' motivation, and at the same time that students want to accept it. In this work, we will show how much online exercises have influence on the results that students get in order to approach systematically to this problematic.

PROBLEM DESCRIPTION AND LITERATURE REVIEW

Since the beginning of the 1990s, the use of Web-based courses has been increasing constantly in all types of education and a tendency towards discovering new educational learning methods has emerged. A US study shows that among most colleges and universities (institutions with 15000 or more registered students), more than 96% of them offer online courses [1]. During the autumn of 2005, the same study showed that about 3.2 million students were enrolled in at least one online course in the US, about one million more than in the previous year. These studies show that an educational technological revolution has resulted in the increase of e-learning usage.

The development and use of any e-learning program represents an individual, organizational, and social investment. Therefore, the efficiency of e-learning should be evaluated. Efficiency measurement can represent a useful tool for the substantial decisions used in the application of any e-learning strategies. [4].

Ivankova [5] stated that a unique learning and teaching experience using a combination of research methods, through IT, teachers, and students, enriches the system of collecting information in a synchronized learning environment and gives the student a greater role in terms of knowledge acquisition. A distributed learning environment through IT affects students who attend traditional classes. The results showed that synchronized support through rich media presentations enhances the students' satisfaction with online courses.

Mccown [7] argues that combined courses can make the best use of both ways of teaching, online and traditional. There are many advantages for teachers and students, including flexibility and the students' increased participation in the process of acquiring knowledge. However, achieving this result is time-consuming.

A research study compared the group F2F and an online group, subjecting them to master a matter under the same conditions. The exam held for both groups showed that the online group was more efficient, according to both the exam results and the students' own perceptions [2].

In a study presented by Koenig [6], three groups with different work methods were formed in a classroom, using online and video conferencing, with the aim of comparing performances. The study showed that distribution in a classroom is more effective than the technology online distribution, and a bit more effective than video conferencing. It is also given a modality that can be used in universities in terms of different ways of knowledge distribution through the proper use of these three ways of knowledge distribution.

Many researches deal with blended learning as one of the possible learning systems, on that is in a way both simple and complex. There is a significant intuitive concept of advantage integration of synchronous and asynchronous learning in teaching activities. At the same time, there is a significant complexity in its implementation in challenges of almost unlimited possibility of the composition and applicability to so many contexts.

Online knowledge distribution in the US has an intensive use and it has been shown to be getting on construction rationalization of new facilities. On the other hand, faculty spend less time on lectures, and more time on interaction with students. Students spend less time passively listening to lectures, and more time actively participating in the course, solving tasks. Through their research works, many authors believe that blended learning demonstrates effectiveness, which justifies its further use. Of course, there are those who deny this, due to insufficient readiness

of the course participants, to devote more time to proper designing of the same, taking care of pedagogical and social principles [8]. The previous research that deals with blended learning in terms of students' attitudes in general show that, if there is a well-designed model combined with traditional class, students had positive attitudes toward the efficacy of blended learning [3]. Knowledge fortification is best achieved through use and practice in concrete assignments. The main usage of knowledge is step-by-step through end of chapter exercises. Advanced usage of knowledge is done at the end of every teaching unit (several chapters together). A user gets assignments which have to be solved through real application. The aim of the assignment is either explained throughout words or a desired final result is presented, and it is required to be done by the user himself.

Estimation tests are formed in order to simulate real problems. In that way, results show the real influence that a user's knowledge will have on business performance. During a knowledge check, results are associated with learning objects, and these instruct students to review the teaching units for which they did not get good results.

SAMPLE

In the research, students of electrical engineering profession participated, profession: electrical engineer of computer technique and automatic – classes I, II and III. The classes were mixed by gender structure, namely – to 34 schoolgirls and 60 schoolboys. Students were also mixed by address, namely – to 32 students from urban area and 62 students from countryside.

Exercises that were the addition to the experimental group were created in the Claroline administrative frontend and were in the form of multiple choice, accession and addition. These exercises are independent variable because they were not taken into consideration during evaluation, but they had the role of improvement and increase of students' motivation.

METHODOLOGY

Before the experiment, we conducted anonymous surveying by the questionnaire with which we tried to

get into the matter in the experimental group about: possession of preconditions for e-learning usage, reasons of using a computer, thoughts about subject informatics and desires concerning the results enhancement from this subject.

Also, we were interested in the possibility whether using computers and Internet can improve students' knowledge level and increase students' motivation towards acquirement of informatics matter through synchronized access and through communication with teacher by mail.

After conducted survey, we introduced students with e-learning terms, which offers us the way of material access at the Claroline system, the way of testing and knowledge evaluation and other elements which this system contains. As most of students of this group didn't have *mail* which is necessary for communication teacher-students towards the better communicating and informing, they got instruction to create mail on their name. After that, we approached the users' registration on the Claroline system towards the prevention of other students' registration for better following and conduction of the experiment. Every student got specific instructions in written form, username and password. After the beginning of the experiment, students could approach the system for practicing. That was necessary, especially for students of the first grades, who don't have enough previous knowledge, in order to eliminate all possible problems during the testing.

At students' recommendation, we also created themes within a forum which students could use in the Claroline system, mutually communicate at the posted topic.

After the experiment conduction, we conducted survey's questionnaire among students from the experimental groups, in order to deduce the level of understanding teaching materials done with the help of computers and ITS. We wanted to gain knowledge about the effects of some used system components (questions clarity at the Claroline platform), about stage fright appearance and its experience through positive or negative experience, and about pleasure and results of studying in given conditions.

Throughout this way, we wanted to evaluate the effect of this manner on the enhancement of students' motivation for studying. We stated earlier that very small students' motivation for studying teaching materials is present nowadays in schools.

During this research, there were used the results taken from questioning e-learning effect on students' success and motivation. With this research, we want to see how big influence of the exercises conducted in e-learning frontend can have on the results which students get on the final test.

Students acceded to exercises according to online tests after processed teaching themes at the class in classroom. Questions are conceptualized in such way that they covered the matter which was covered by teachers till that moment. Questions were varied by type and content, and they were questions of multiple choice, addition and connection between terms.

During the questioning that lasted two months, students had three exercises according to the principle when they had the obligation to access e-learning exercises after one thematic unit is being done. At the end, they did the final test in classroom through classical way of doing the final test.

During results processing, software Statistic 8 was used.

STUDENTS ATTITUDES

The important question is whether there are students' interest, motivation and readiness to learn and discover something new in this way, with IKT intercession. In the survey we conducted on 94 students, we asked: "If u had a choice, what would u chose?" We gave three possible answers on that question:

- Traditional,
- E-learning,
- Combination of traditional education and e-learning.

The results of survey are such that 73 examinees (77.6%) accepted the answer – combination of traditional and e-learning. These results show that students are interested for changes and acceptance of this kind

of education. It is encouraging that interest exists, and especially that it is the biggest for that kind of education which currently have the biggest success in the world. On the other side, the result is even bigger when we know that this kind of education is still at the beginning in high school education. This term is related to the combination of traditional education and e-learning where the best elements of both types of education are included.

After the end of the research, the result of the survey is such that 79% of students completely understood the content they had in the Claroline system environment. 14% of them understood partially, and 6% of them didn't understand the content. Even most of them understood teaching matter, this shows that there are also those who didn't understand the matter partially or in no way, and that students should be more educated in order to use this kind of studying without problems.

The aim of the survey's question: "What is the informatics teaching in blended system in relation to classical teaching?", was to show students' attitude towards blended system. The result of the survey's question is such that 80% of students answered that the informatics content is more interesting with using e-learning system and most of students want to continue this kind of education. 74% of them want that continuously, while just 15% of them want it occasionally.

Also, it must be taken into consideration that students and teachers from our country mostly didn't have the experience with e-learning, but still they recognize its advantages. Here, the resistance to changes even for this kind of education is still present because of unknowing the world's trends and thoughts that e-learning doesn't have the same status as traditional education. So, this is also the difficulty of its development.

These students' attitudes justify this research towards the obtained methods and direction in which blended education system in high schools of Bosnia and Herzegovina should be developed. On the other side, it is necessary to define the individual effect of some elements, which LMS platform contains, on the students' results - in this case, the influence of the exercises on the students' results in classical tests.

RESULTS AND DISCUSSIONS

The aim of the results which will be showed is to define part of exercises results and the influence of the same on the final students' result on the final test. For researching the influence, it was used the canonical-correlation and regression analysis.

These results primarily need to show at which way we can integrate e-learning with classical way of education. According to conducted surveys at the end of the research, it is noticeable that students are pleased with the way of communication among participants of this process and that this way suits them concerning the establishment of the matter. Also, it is noticeable that students understand questions in the context of answering, which makes them very interesting, especially because, after the finished testing in e-learning frontend, students points to mutual understanding of specific attitudes related to possible answers on the posted questions and to additional gaining knowledge about problematic that treats those questions. Students often use the forums created on the LMS platform as well as *chat* in mutual communication and communication with teacher. The advantage is that they get the results achieved during exercises right a way and that they can have insight in their results achieved in online exercises immediately.

Difficulties in constructing online exercises by students can appear in the case when we have loaded telecommunication networks, and also the time barrier which is there in the sense of answering on the posted questions. That is the case when it is wanted to prevent manipulation and abuse, so their time for creation online exercises is limited. So it happens that they don't have enough time for thinking. The second problem occurs concerning the acquirement of gained knowledge at this way, as practical uses of dealing a problem, which can occur in real practice, are not available for them.

The students' results of the exercises are shown under the marks V1, V2 and V3, while the students' results of the final test are under the mark ZT. The final test contained the informatics matter which was previously covered and which was practicing throughout e-learning exercises. The matter was constructed for all classes, and it was planned to be covered during that period according to informatics curriculum.

In this research, the results achieved in the II and III grade will be shown.

In the second grade – Table 1., as it is noticeable, only one latent dimension, which the overall effect on the result of the final test explains with 90.18%, while the structure of isolated canonic factors of exercises and final test was given in the table of canonic factors. Considering the structure of isolated canonical factor, it is noticeable that the results of the exercises achieved in V3-2 have the biggest influence, i.e. exercises that preceded the final test.

TABLE 1. CHARACTERISTIC ROOTS AND EXPLAINED PARTS OF COLLECTIVE VARIANCE

	Eigenvalue	% Total - variance	Cumulative - Eigenvalue	Cumulative - %
1	3,607222	90,18055	3,607222	90,1806
2	0,212101	5,30252	3,819323	95,4831
3	0,109776	2,74440	3,929099	98,2275
4	0,070901	1,77253	4,000000	100,0000

TABLE 2. CANONIC FACTOR STRUCTURE

	F1
V1-2	-0,955000
V2-2	-0,915003
V3-2	-0,962820
ZT-2	-0,964854
Expl.Var	3,607222
Prp.Totl	0,901806

In the table 3., the mutual connection of students' results achieved at some exercises and the results achieved on the final test can be noticed. It is also noticeable that there is a correlation between results of some exercises as it is a word about the matter which is mutually connected, and it couldn't just be observed as unique thematic unit concerning the matter covered for this informatics class.

Correlations are more than usual, probably because examinees are aware of belonging to the experimental group and it cannot affect intelligence development. That is why the real variability and collective co-variability were enlarged on all tests because of that. This fact gives us the stronger security in the interpretation of correlations between intelligence and knowledge.

TABLE 3. THE MATRIX OF VARIABLES INTER-CORRELATIONS

	V1-2	V2-2	V3-2	ZT-2
V1-2	1,00			
V2-2	0,82	1,00		
V3-2	0,90	0,83	1,00	
ZT-2	0,90	0,83	0,93	1,00

The value of canonic correlation coefficient of Table 4. is 0.891, Chi-square=61,088 with three levels of freedom; $p=0,000$ is statistically significant. It means that there is statistically significant connection between exercises and the final test.

Canonic correlation analysis was applied with the purpose of making maximum connections, i.e. relations between two observed data groups. With the use of Bartlett Lambda's test and his testing with suitable h^2 -square test, it is confirmed that the results achieved at some exercises are connected in some way to the results achieved on the final test, with one pair of canonic factor in the statistically significant level $p=0.00$. The connection between the first pairs of canonic factor is very large what confirms the size of canonic correlation coefficient which is $R=0.944$ and the explained part of collective variance from 89.1%.

TABLE 4. ISOLATED CANONIC FUNCTION

	Canonic - R	Canonic - R-sqr.	Chi-sqr.	df	p
0	0,944215	0,891542	61,08829	3	0,000000

Concerning the regression coefficients of BETA and its value Q (BETA), it can be concluded that the most influence on the final result will have those exercises which precede the testing, in this case (V2-3). But, the first exercise V2-1 also has statistically significant influence. Partial standardized regression coefficient for predictor variable of the first exercise is $\beta=0,326$, $t=2,154$ with $p=0,04$, while for the third exercise is $\beta=0,552$, $t=3,612$ with $p=0,00$.

Statistics show that the biggest partial effect on the results of the final test gives results at exercises which precede the test. While other exercise can have the smallest effect because questions in that test were with multiple choices only, so we can explain this decreased effect. Based on the values of non-standardized coefficients of regression, the regression equation can be formed in this way:

$$ZT-3 = -16,22 + 0,379 * V1-2 + 0,152 * V2-2 + 0,832 * V3-2$$

Based on this equation, the overall expected results can be expected on the final test.

TABLE 5. REGRESSION ANALYSIS

	Beta	Std.Err. - of Beta	B	Std.Err. - of B	t	p-level
Intercept			-16,2233	5,880102	-2,75902	0,010281
V1-2	0,325517	0,151107	0,3795	0,176170	2,15421	0,040310
V2-2	0,101868	0,120161	0,1518	0,179059	0,84776	0,404023
V3-2	0,552301	0,152922	0,8323	0,230439	3,61166	0,001224

In the III grade – Table 6., it can be seen that only one latent dimension was isolated. The latent dimension elaborates the overall effect on the results of the final test with 73.8%. The structure of isolated canonic factors of the exercises and final test is given. Considering the structure of isolated canonic factor, it is noticeable that the biggest effect have the results of the exercises achieved on V3-3, i.e. the exercises which preceded the final testing.

TABLE 6. CHARACTERISTIC ROOTS AND ELABORATED PARTS OF COLLECTIVE VARIANCE

	Eigenvalue	% Total - variance	Cumulative - Eigenvalue	Cumulative - %
1	2,953012	73,82531	2,953012	73,8253
2	0,549684	13,74210	3,502696	87,5674
3	0,353814	8,84535	3,856510	96,4128
4	0,143490	3,58724	4,000000	100,0000

TABLE 7. STRUCTURE OF CANONIC FACTOR

	F1
V1-3	-0,753953
V2-3	-0,833197
V3-3	-0,929705
ZT-3	-0,908845
Expl.Var	2,953012
Prp.Totl	0,738253

In the table of matrixes of variables inter-correlations, mutual effect of exercises and the final test can be noticed. This is similar as in other classes, although there is smaller intensity of correlation among results achieved during some exercises. This can be explained as in this class students study C++

language and it is a word about repeating orders which have their specificities. That correlation relationship tells us also about mutual similarities which control some of repeating orders.

TABLE 8. MATRIX OF INTER-CORRELATION VARIABLES

	V1-3	V2-3	V3-3	ZT-3
V1-3	1,00			
V2-3	0,48	1,00		
V3-3	0,58	0,73	1,00	
ZT-3	0,59	0,65	0,85	1,00

The value of canonic correlation coefficients is 0.733, Chi-square=40,343 with three levels of freedom, p=0.000 is statistically important. It means that there significant correlation between exercises and the final test.

Canonic correlation of analysis was applied for the purpose of defining maximal connectivity, i.e. relations between two monitored data groups. By applying Bartlet Lambd's test and his testing with the help of the suitable h² – square test, it was declared that there is, in a certain matter, the connection between the results achieved during exercises and the results of the final test with one pair of canonical factors at statistically envious level of p=0.00. The connectivity between the first pair of canonical factors is very high which is confirmed by the size of canonical correlation coefficient which is R=0'86 and the elaborated part of the collective variance of 73%.

TABLE 9. ISOLATED CANONICAL FUNCTION

Canonicl - R	Canonicl – R-sqr.	Chi-sqr.	df	p
0	0,856498	40,34282	3	0,000000

Based on regression coefficients of BETA and its importance Q (BETA), it can be concluded that exercises which precedes the testing will have the biggest influence on the final outcome in this case (V3-3). Partial standardized regression coefficient for predictor variable of the first exercise is beta=0,722, t=4,844 with p=0,00.

The data shows how the results during exercises which precede the test had the biggest partial influ-

ence on the final test results. On the other side, the other group of exercise had the smallest influence because questions in that test were only of multiple choice, so with that we can explain this small influence. Concerning the values of non-standardized regression coefficients, regression equation can be formed in this way:

$$ZT-3 = -24,33 + 0,201 V1-3 + 0,132 V2-3 + 1,216 V3-3$$

Based on this, we can calculate the overall results on the final test.

TABLE 10. REGRESSION ANALYSIS

	Beta	Std.Err. - of Beta	B	Std.Err. - of B	t(30)	p-level
Intercept			-24,3309	10,61937	-2,29118	0,029150
V1-3	0,131781	0,116654	0,2013	0,17821	1,12967	0,267565
V2-3	0,067650	0,137465	0,1319	0,26802	0,49213	0,626212
V3-3	0,721873	0,149032	1,2159	0,25103	4,84375	0,000036

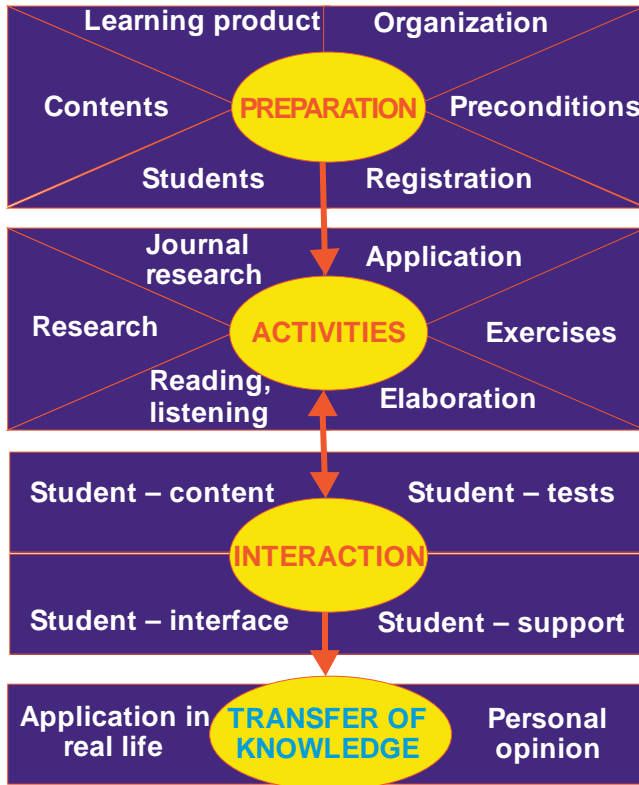
Throughout the results showed in this research, we can notice the influence of the predictor variables (exercises) on the criteria variable (the results achieved on the final test), concerning that this influence is more expressed in other classes. This research had multidimensional access towards checking the reliability of the data taken over this research. Of course, this initial researching is not completely reliable due to small results' number and short time period. In order to get the statistical reliable results, this research have to be followed in one longer time period and on the bigger samples' number.

But it is without a doubt that the influence exists, but we can't define precisely how big the real influence is. and through the results in practice of questioned population, the improvement is noticeable, not only through achieved results on the final test, but also the evident influence on the improvement related to students' motivation for discovering something new.

KNOWLEDGE TRANSFER

We further introduce another performance index, the knowledge transfer. The performance of knowledge transfer is closely associated with the

FIG.1. TRANSFER OF KNOWLEDGE



number of replicas of a given knowledge in the community. Different from the knowledge variety, the knowledge replica is defined as coexistence of homogeneous knowledge. In the knowledge sharing community, we need some identical knowledge to exist because this helps participants more easily gain certain type of knowledge from a “closer” community member. Since is the probability that the participant i shares certain knowledge, we denote the expected number of replicas of a type of knowledge in the community as $Ri(x1, x2, \dots, xn) = \sum_{i=1}^n x_i$
 $Ri(x1, x2, \dots, xn) = \sum_{i=1}^n x_i$

We further assume that the transfer effort (e.g. delay) between any two participants is a random variable with value drawn from a transmission delay density function. Participants always retrieve knowledge from a community member with a minimum transfer effort. Denote the expected minimum transfer effort among k community members by $T(k)$. Using order statistics, we have:

$$T(k) = \int_0^{\infty} t \cdot k \cdot (1 - F(t))^{k-1} \cdot f(t) \cdot dt$$

where $f(t)$ and $F(t)$ are the PDF and CDF for the transfer effort. In this paper, we analyze the community

configuration based on uniform distribution $U[0, T_0]$ $U[0, T_0]$ where is the upper bound of transfer effort. Thus, given individual knowledge sharing level $(x1, x2, \dots, xn)$, the expected transfer effort is:

$$T(R) = \left(\sum_{i=1}^n x_i + 1 \right)^{-1} T_0$$

Lastly, we denote the value of a transfers knowledge as v_i , and assume the cost of transfer effort and sharing cost for a knowledge are and respectively. The utility function is defined as follows:

$$U_i = v_i - \beta i T(R) - c_i x_i = v_i - \beta_i \left(\sum_{i=1}^n v_i + 1 \right)^{-1} T_0 - c_i x_i$$

CONCLUSION

This research is in the context of the integration of contemporary discoveries and the IKT and Internet usage in the classical education system. Blended learning system is only possible in high schools, not only because of the legal barriers but also because of the social and pedagogical factor. Namely, in this kind of teaching, we don't lose the social and pedagogical principle because students still hang out and exchange their thoughts. On the other side, they have direct contact with teachers through classical education and in that way we get on quality of all factors needed to be pleased according students age towards the educational teaching as well as moral teaching.

Throughout the survey, with this kind of students' access, the pleasure is noticeable. There was needed even less time in order that students accept online teaching in comparison to teachers who have the negative attitude towards the same. It can be explained on the situation that in Bosnia and Herzegovina teachers don't have suitable informatics literacy so due to that, this resistance over blended learning system can be explained.

Throughout research, the increased influence of online exercises on the final test results is noticeable as the statistically significant influence can be noticed in the II and III grades. It is also noticeable in canonical-correlation and regression analysis which tested the achieved results. In both cases, the results matches which tells us about the reliability of the achieved results which were taken over the treatment

of exercises and final test of this population.

This research shows the universal solution for defining the influence of online exercises on the final test results which students achieve on the final test done in classical way. Qualitative changes were made after adequate conducted exercises where they took into account all aspects which were presented in experts research towards the creation of the same.

This research shows statistically significant influence of exercises on the final test results. It can be useful for the future research in this sector that would

be conducted over longer period of time. Even the institutions which deal with creation of education strategy can benefit from it in order to strategically access the planning implementation for all online exercises subjects. However, besides all inaccuracy we mentioned, the survey also confirms that students have the interest towards this kind of testing, and in every case, the increased students' motivation is noticeable. Therefore, competent institutions should approach to the integration of this type of education due to students' results and the increase of informatics literacy of students and institutions' personnel.

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