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USE OF EDUCATIONAL INFORMATION SYSTEM FOR IMPROVING THE PERFORMANCE OF INDIVIDUALS WITH OR WITHOUT LEARNING DIFFICULTIES IN MATHEMATICS

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ABSTRACT

In this paper, it is examined the use of Educational Information System to improve the performance in Mathematics to students with and without learning difficulties at Piraeus University of Applied Sciences (TEI of Piraeus) and University of Athens. Also, it is examined the use of Educational Information System to improve the performance of employees in Mathematics in the public and private sector in Athens-Greece. The sample is divided into two groups (Group A' & B') with and without learning difficulties. This research aims to explore the use of Educational Information System in order to improve the performance of adults in Mathematics. The diagnosis of dyscalculia was held twice for these groups in order to be approved the hypothesis of the performance for crowd to be improved by using Educational Information System. It is examined the time and the performance were made by the groups of this research in hard copy and e-learning exercises in Mathematics. The results supported the hypothesis that the use of Educational Information System improves the performance of the crowd with and without learning difficulties in an asynchronous educational system in Mathematics.

Subject Classification*: Equations named after people, Computer Science and Mathematical Research, Statistics*

Short Title*: Performance in Mathematics for individuals with Information Systems.*

Keywords: *Education Information System, Improvement of Performance, Students, Employees, Learning Difficulties, Mathematics, learning environments.*

1. INTRODUCTION

In the first part of this investigation, the sample is answered four questions in hard copy at Mathematics. It is admeasured the correct answers, the time that they needed to solve the exercises and is estimated their performance, too. The level of these exercises was that the primary school, in order to be known to the sample. For instance, solution of equations, etc.

In the second part of this survey, all participants are resolved exercises in Maths by using an Education Information System, called e-learning (learning@home.gr)- "in Greek" [15] which is a result of three enterprises: "Publications Smyrniotakis", "MAX Productions" and "ACTION SYNERGY", by their P/C. The exercises that included in the Information Education System were similar to the hard copy exercises, in order to avoid the risk of understanding by the crowd.

In the third part of the investigation and after three months of using above Information Education System granted again the "Dyslexia Adult Screening Test" (D.A.S.T.) [7] in the entire sample.

The study of the performance's was correlated by using Information Education System, the hard copy exercises and the repeated giving tool: "The Dyslexia Adult Screening Test (DAST)".[7]

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For the purposes of the investigation, it was used as descriptive and inductive statistics the statistical package "SPSS 16".

The mean values (mean) and standard deviations (Standard Deviation = SD) and / or median (median) and interquartile ranges (interquartile range) were used for the description of the quantitative variables. Absolute (N) and the relative (%) frequencies used for the description of qualitative variables. To compare quantitative variables between two groups, it was used the nonparametric Mann-Whitney Test. When comparing the factors between two time measurements used the nonparametric Test Wilcoxon signed-rank Test.

To determine if the changes in measurements in time were different between the groups analysis of variance, repeated measurements ANOVA were used. Because, the studied variables did not follow a normal distribution, their ranks are used. The ratio was compared with the criterion x^2 test. The level of significance is bilaterally and statistical significance was set at 0.05. The correlation coefficient of r "Spearman" is used, too.

Exercises for Maths were in a primary level. They were four exercises of a total 48 correct answers. The rating scale was 1-10.

The structure of "learning @ home" [15] is designed for each lesson in the manner and order exactly what the student is taught in the school of the curriculum. So, the user has the possibility at any time to select, repeat the process of teaching in the classroom, on his computer:

- Listening to the lesson from the teacher.
- Attending the teacher to deliver and explain the lesson as many times as the student wishes.
- Having at his disposal all the necessary documents and all kinds of educational materials, which help the student in the course.
- Checking constantly the knowledge acquired through the exercises.

In each lesson, an introduction of the course emerges with the appropriate option a video, which shows a teacher who speaks about the rules that needed for solving mathematical exercises.

The system checks the answers of this unit for each student/employee. There is an indication to the correct answers, sounding audible tone the users. When somebody solves the exercises of this section, the user can proceed in the following sections. The way of the exercises's selection is simple.

People with learning disabilities do not usually have sufficient numbers memory.

The total number of exercises for mathematics in electronic form was 41 exercises. In particular, participants were tested in six sections - tests. In detail, the modules are:

- Section 1: "Numbers and Operations - Natural Numbers" (12 exercises)
- Section 2: "Equations - The concept of the variable" (3 exercises)
- Section 3: "Reasons , Proportions - I find the rates" (4 exercises)
- Section 4: "Data Collection & Processing - illustrated with bar charts data" (5 exercises)
- Section 5: "Measurements" (12 exercises)
- Section 6: "Geometry - Geometric shapes Polygons" (5 exercises)

The total number of correct answers for the above modules are: 21, 6, 22, 20, 17, 23 responses, respectively.

"E-learning – Smyrniotakis" [15] export performance results of each participant of the survey, at the end of solving the exercises. The measurement results of each participant rated excellent performance 10 and count the correct answers to all the correct answers for each exam in Mathematics.

The LMS (Learning Management System) support some tools, which distributed as: "Course Management", "Class Management", "Communication Tools", including tools for synchronous and asynchronous communication, via e-mail, chat, discussion forum, audio/video conferencing, notes, whiteboard, files, etc. "Content Management" in which is included learning material, files, folders, too. "Assessment Tools", such as delivery of reports of performance in the Internet, statistics for the actual attending of courses by the users, "School Management" which contains tools, such as presences, degrees, records of the students, economical subjects, statistics, etc. [1]

It is estimated that 10.000.000 courses are offered in the Internet mainly in the U.S.A., as well as corporations which use e-learning, approach the number of 700 almost. [11]

Additional activity consists of various types of Internet Information Systems in order to educate employees and improve their performance, through e-learning [5]

The benefits of e-learning are known to the people with or without learning difficulties. The individuals without learning difficulties have even temporarily the same restrictions as the individuals with learning difficulties. For instance, individuals with learning difficulties that the English language is considered as the second learning language, they face the same difficulties with the individuals without learning difficulties. [3]

In addition, there are five columns of the Asychronous Learning Network-ALN": Learning Effectiveness, Faculty satisfaction, Student satisfaction, Cost effectiveness, Access. [12] All these systems increase the effectiveness, improve the quality, the productivity and the profits [9]. A rapidly increasing number of organisations train their employees via the Internet, including the Universities and Colleges, military bases and even the schools [11]. The use of various kind of Information Systems has an additional activity, to train the employees and improve their performance, through e-learning [5]. A, moreover, Management Information System that was incorporated in the Educational Information System is the "e-learning platform", which is called "e-Aula" [14].

Students who use written synchronous interactions with chat rooms produces two to four times more sentences with greater variety of functions. [10]

The most Information Systems work on the architectonic of general Systems. A plenty of Information Systems work on the architectonic of general systems [13].

2. SAMPLE

In this survey involved 108 people. Fifty four had learning difficulties (Group A) and 54 had not learning difficulties (Group B). Learning difficulties had 54 people and the diagnosis of dyslexia is turned out by the psychometric tool "DAST", [6] which contains test for number memory. Their ages was range from 18 to 58 years old.

More specifically, in this research are involved 24 students of University of Athens, 50 students from P.U.A.S., 22 employees in the public sector, entities and 12 employees from the private sector. In the present research, students and employees are selected from the region of Attica-Greece.

General population's individuals had the same socio-economic and educational level as well as similar age compared to 54 individuals who had learning difficulties, in order to be conducted valid and reliable results in the comparison of two above groups.

The following table, the distribution of the sample is depicted as to the faculty/status of the crowd.

Table-1

	Frequency	**Frequency (%)**
Students	74	68,5
Employees	34	31,5
Total	**108**	**100,0**

3. RESULTS

3.1 Performance by the test "Number Memory" before the e-learning exercises in Mathematics

In the table listed below, it is shown the performance of the test "Number Memory" in the first part depending on existence or not of learning difficulties

"Number Memory"	**Groups**			
	Group A		**Group B**	
	f	*(%)*	*f*	*(%)*
Good Level	0	(0)	0	(0)
No problem	11	(20,4)	49	(90,7)
Small problem	5	(9,3)	5	(9,3)
Median problem	24	(44,4)	0	(0)
Big problem	14	(25,9)	0	(0)
Mean±SD	3,8±1,1		2,1±0,3	
Median (Inquart. range)	4 (3 - 5)		2 (2 - 2)	
Mann-Whitney *U*	337,00			
p	<0,001			

According to the above table, it is observed statistically significant differences between two Groups (Mann-Whitney *U*=337, 00, *p*<0,001). Specifically, the adults without learning difficulties had better performance (*M*=2, 1, *SD*=0, 3) by the test "Numbers Memory" in comparison with the adults with learning difficulties (*M*=3, 8, *SD*=1, 1). The percentage 44,4% and the percentage 25,9% of adults with learning difficulties had median and big problem by the test of "Memory Number", respectively, while the percentage 9,3% of adults had a small problem. On the other hand, it was found that one to ten adults without learning difficulties had a small problem.

3.2 Performance by the test "Number Memory" after the e-learning exercises in Mathematics

In the table listed below, it is shown the performance of the test "Number Memory" in the third part depending on the existence or not of learning difficulties.

"Memory Number"	**Groups**			
	Group A'		**Group B'**	
	f	*(%)*	*f*	*(%)*
Good Level	13	(24,1)	24	(44,4)
No problem	8	(14,8)	30	(55,6)
Small problem	0	(0)	0	(0)
Median problem	27	(50,0)	0	(0)
Big problem	6	(11,1)	0	(0)
Mean±SD	3,1 ± 1,4		1,6 ± 0,5	
Median (Inquart. range)	4 (2 - 4)		2 (1 - 2)	
Mann-Whitney *U*	666,00			
p	<0,001			

According to the above table, statistically significant differences are observed (Mann-Whitney *U*=666,00, *p*<0,001) between two groups. Specifically, the adults without learning difficulties (*M*=1,6, *SD*=0,5) had better performance by test "Memory Number" after solving e-learning exercises in Mathematics in comparison to the adults with learning difficulties (*M*=3,1, *SD*=1,4). Also, it was found that almost two to five adults with learning difficulties had a good level (24,1%) or had no problem (14,8%) by the test "Memory Number" after solving e-learning exercises in Mathematics. On the other hand, adults without learning difficulties (55,6%) had no problem after solving e-learning exercises in Mathematics.

3.3 The following table depicts the total score of the participants in Mathematics, as hardcopy exercises as well as e-learning exercises, depending on the existence or non learning difficulties

	MATHEMATICS					**P****	**P‡**
	Hardcopy Exercises		**Electronic Exercises**		**Change**		
Groups	**Mean±SD**	**Median (Interquartile range)**	**Mean±SD**	**Median (Interquartile range)**	**Mean±SD**		
Group A'	6,4±0,6	6 (6 - 7)	7,7±0,5	7,8 (7,3 - 8,2)	1,3±0,7	**<0,001**	0,143
Group B'	7,4±0,7	7 (7 - 8)	8,5±0,4	8,5 (8,2 - 8,8)	1,1±0,8	**<0,001**	
p*	<0,001		<0,001				

* Difference between groups

** Difference between measurements .

‡ Repeated measures ANOVA. Differences in the change from one measurement to the other between the groups.

Adults without learning disabilities had significantly higher grades in mathematics compared to adults with learning difficulties. Also, two groups are scored significantly higher in e-learning exercises of mathematics. The grade of change in mathematics between two groups did not differ significantly.

3.4 Performance differences of hardcopy exercises in Mathematics depending on whether they are students or employees

Performance of the hard copy of Mathematics's exercises	**Students**	**Employees**	Mann-Whitney *U*	*p*
	M (SD) Median	*M (SD) Median*		
Grades/10	6,92 (0,77) 7,00	6,79 (0,84) 7,00		

Correct answers in total of 48 correct answers	28,53 (1,33) 29,00	28,44 (1,73) 29,00	876,50	0,417
Time in minutes by researcher	13,07 (1,75) 13,00	12,71 (2,26) 12,50	915,50	0,634

In the above table, statistically significant differences are not found in the grades of hard copy of Mathematics's exercises between students and employees (Mann-Whitney *U*=876, 50, *p*=0,417). Also, it not found statistically significant difference during timing in solving hard copy of Mathematics's exercises depending on what they are students or employees (Mann-Whitney *U*=915,50, *p*=0,634).

3.5 Performance differences of e-learning exercises in Mathematics depending on what they are students or employees

Performance by e-learning of Mathematics' s exercises	**Students** *M* *(SD)* *Median*	**Employees** *M* *(SD)* *Median*	Mann-Whitney *U*	*p*
Grades/10	8,10 (0,60) 8,17	8,16 (0,60) 8,25	812,50	0,213

Statistically significant differences were not observed in grades for electronic form of Mathematics exercises between two groups (Mann-Whitney *U*=812, 50, *p* = 0, 213)

4. CONCLUSIONS

This Information Education System has prompted the participants to improve their knowledge in Mathematics and resolve more electronic exercises in comparison to the hard copy exercises. The sample solved more electronical exercises in less time and with fewer errors. In other studies, it was found that the average student's group as regards the finding in the accuracy of the word using the program "Write: Outloud", the rate reached 95.1 % and by using the program "Co:Writer", the rate reached 95,98% [16].

Through the special platform of Mathematics, the students and the employees of this research were entered numbers, as well as the formats and the images of Mathematics Formulas were in bright colors and a large size. This is a friendly environment, for using it, individuals with learning difficulties. The use of "DisMath" system by incorporating another softwares can help students with learning difficulties in using mathematical formulas to solve mathematical operations. [8]

Moreover, the improvement of the performance's students with learning difficulties in Mathematical operations can be seen from a small sample of students with learning difficulties. They were used calculator for solving Mathematical operations and 40,5 % of students were helped by using the calculator. While, the students without learning difficulties were helped by using calculator in order to solve mathematical operations in percentage 13, 8% [2]

Moreover, students with dyslexia, who were used "ipod-touch", had better progress in comparison to students, who did not use such technology [6]

The results supported the hypothesis that the use of Educational Information Systems improves the performance of the adults with or without learning disabilities. This documentation is consistent with the findings of other similar studies [18], [19]. Virtual and remote laboratories are e-learning resources which enhance the learning needs of students. [4]

In total, the findings of this research revealed that the students and employees with learning difficulties have difficulties in writing correctly at hardcopy exercises at Mathematics. In conclusion, e-learning is the ideal method of ameliorating learning for individuals with or without learning difficulties.[17] The differences were statistically significant for the sample of this research between hard copy exercises and e-form exercises at Mathematics.

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