Analysing the Relationship between Students' Paper Results and Flash-based Logical Problem Solving in the Course Introduction to Informatics

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***Abstract**: Students of the undergraduate course Introduction to Informatics get acquainted with the most prevalent methods of data concealment (steganography) and data encryption. Students got a logical exercise as homework every week in order to develop their logical abilities. I supposed who could solve them would have better paper results. In the first group were put students who successfully solved the logical exercises, in the second group those who had problem with it. An analysis of the paper results (Levene test) showed the variance of the two groups the same ($p<0,05$). In this case the means could be compared with Independent samples test. This did not show difference between the means ($p<0,05$): the mean of the results of students solving the logical exercises were not significantly better than the results of the other group which was not able to solve them. Calculating the Eta-squared I tried to make percentable the impact of successful problem solving on the result of the papers written and got a surprising 0,5%. This means there is no correlation between the results of the papers written by the students at the end of term and their in-term problem solving work: statistical analysis shows no difference between the two groups.*

***Keywords**: data encryption; data concealment; logical exercise; students; undergraduate course; Óbuda University*

1 Introduction

1.1 Feasibility Study

Students of the undergraduate course *Introduction to Informatics* get acquainted with the most prevalent methods of data concealment (steganography) and data encryption in history as well as with up to date applications [1].

Most of these are difficult to demonstrate at the blackboard not to speak of modern steganographic methods which are generally not applicable in the classroom at all. Concealing information within pictures or voices is impossible to show on the blackboard and you can only partially explain how to apply the LSB (least significant bit) technique.

Therefore I decided to create multimedia applications suitable to conceal text in .BMP or .WAV files not visible or detectable for human eyes and ears, respectively. First I wrote a Borland Delphi program appropriate to show up to date steganographic (data concealing) methods using picture and sound files. To the topic of cryptography I prepared model applications presenting historic cryptographic algorithms as well as applications demonstrating how to decipher these encrypted data (e.g. using and deciphering the Ceasar code, monoalphabetic encryption and it's deciphering, etc.). Another program demonstrating the Vigenére encryption shows continuously which rows and columns are used in the process. Illustrating the Cardano grid a program was written which prepares a rotatable grid adequate to put the characters of the message to the appropriate place in the grid in order to conceal it.

Now I wanted to know the usefulness of all the programs I wrote and an excellent opportunity presented itself by the big number of admitted new students (310 students). These engineering students attended my lectures, held at different dates, in two groups. In the first group of lectures (144 students) I presented and used the programs described above while the lectures for the second group (166 students) were delivered without these materials. My null hypothesis was that the results of the papers written by the two groups of students would not differ significantly. Now we know our hypothesis was correct. We can say the using of multimedia applications when teaching cryptography and steganography is productive, and the students understand the methods easier, and get better result when writing papers. [2]

1.2 The Next Step

In the next semester I gave the students a flash based logical exercise every week and they had another a week to solve it. Earlier it was shown that multimedia applications were useful in teaching cryptography and steganography.

Why have I chosen this as the next step of my analysis? Because the students have have to have a logical attitude of mind to decipher the questions of the paper in order to give the correct answers [3]. I used flash based programs (Figs. 1, 2, 3). Flash based logical exercises are quite similar to multimedia applications, but are not bound to teaching cryptography and steganography. The idea was that students get practice in solving logical excercises with the help of multimedia experience.

I supposed, those who could solve these excercises would have better paper results later.

I chose some flash based logical exercises and I shared it with the students every week. If somebody could solve it, he/she could send me a picture of the solution.

Now I wanted to know the usefulness of all the programs and exercises I used. I sorted the students in two groups after the semester.

The students who solved all of the logical exercises (26 students) were put in the first group (group A) the others (315 students) in the second group (group B). It is important to see, that less than 10% of student could solve all of the logical exercises (which were not too difficult). This means that a very big part of the students have problem with logical thinking. After the semester I summarised the paper results by groups and I tried to analyze whether this method was helpful or not for the students.

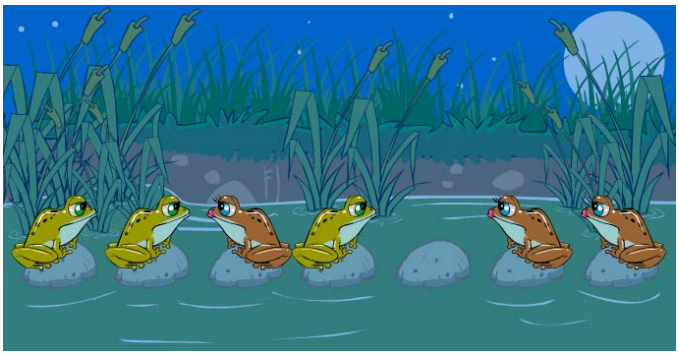

Figure 1
Flash based logical exercise 1

Figure 2
Flash based logical exercise 2

Figure 3
Flash based logical exercise 3

2 Analysis of the Paper Results

Some mathematical analysis was needed to decide whether using these programs and exercises were helpful or not in understanding the lectures, decipher the questions and make the correct answers.

2.1 The Number of Participants in the Two Groups and the Values of Means and std.deviations

According to the table (Table I) the mean of the results of papers in group A is higher. This group wrote the papers with a better result. There is not enough information to say that using logical programs and exercises will resulting better written papers, because this can happen incidentally too. So more analysis was needed to keep the chance of this low.

Table I
Group statistics

Group	Number of participants	Mean	Std. Deviation
A	26	2,06	0,698
B	315	1,85	0,762

2.2 Independent Samples Test

My null hypothesis was that the results of the papers written by the two groups of students would differ significantly. Because we have two independent samples so we can use the T-test to tell if the means of these groups are differing or not (Table II). An analysis of the results (Levene test) [4] of theoretical knowledge showed the variance of the two groups not different ($p<0,05$). In this case the means could be compared with T-test [5] which did not show up a difference between the means ($p<0,05$). The mean of the results of students who resolved the logical exercises were not better mark than the results of the other group who have not successful to solve it.

Table II

Independent samples test

	Levene's test for Equality of variances		**T-test for equality of means**		
	F	**Sig.**	**t**	**df**	**Sig. (2-tailed**
Equal variances assumed	0,624	**0,430**	1,360	339	**0,175**
Equal variances not assumed (Welch's t-test)			1,465	30,140	0,153

2.3 Measures of Association

Earlier, no significant differences could be detected between the means of the two groups. The influence of the chosen group on the calculated means can be revealed with the calculation of the Eta-squared (H^2) [6]. For the calculation of the Eta-squared first we have to calculate the main mean $(\overline{\overline{x}})$ (1)

$$\overline{\overline{x}} = \frac{\sum_{j=1}^{m} n_j \overline{x}_j}{\sum_{j=1}^{m} n_j} \tag{1}$$

where n is the number of musters, $\overline{x}$ is the mean of the musters and m is the number of musters We have to calculate the values of the variance Between-Groups Sum of Squares (SSB) (2) and the variance Within-Groups Sum of Squares (SSW) (3), where the standard deviation of musters (s_j) appears in the formula.

$$SSB = \frac{\sum_{J=1}^{m} n_j (\bar{x}_j - \bar{\bar{x}})^2}{\sum_{j=1}^{m} n_j} \tag{2}$$

$$SSW = \frac{\sum_{j=1}^{m} n_j s_j^2}{\sum_{j=1}^{m} n_j} \tag{3}$$

The Total Sum of Squares (SST) is the summation of the variance between groups and the variance within groups (4).

$$SST = SSB + SSW \tag{4}$$

The following table shows the calculated values (Table III).

Table III

Calculated values of main mean and variances

$\bar{\bar{x}}$	**SSB**	**SSW**	**SST**
1,86	1,060	194,349	195,409

The value of the Eta-squared (H^2) is the quotient of the variance between groups and the total deviation quadrate (5).

$$H^2 = \frac{S_k}{S} \tag{6}$$

The calculated value in percentage shows how much the grouping influences the difference between means. Square root from the Eta-squared (7) gives a value between 0 and 1 (H).

$$H = \sqrt{H^2} \tag{7}$$

This shows the measures of association, i.e. how strong the connection between grouping and the achieved result is. The higher the value, the stronger the connection. In the next table we can see the calculated values and the strength of the connection (Table IV).

Table IV

Measures of association

H^2	H	Strength of the connection
0,5 %	0,074	no connection

Having calculated the Eta-squared we see that the paper results show no difference by grouping. This means there is not connection between the grouping and the students knowledge level. The results of Eta-squared confirmed the results of the independent samples test.

Summary

According to the starting hypothesis exposed in the introduction students from group A should have better paper results than students from group B. The analysis of the paper results showed the students' paper results not differing so the original hypothesis was not correct. In other words, students who solved the flash based logical exercises did not produce better results than those who could not solve it meaning that using this application was not productive.

Earlier, multimedia applications applied in teaching cryptography and steganography proved helpful [2], but flash based logical excercises not.

It is amazing that less than 10% of students were able to solve the easy exercises. This probably means that students of this generation either have not enough motivation to solve logical exercises or simply they are not able to do it. In either case the situation is cheerless.

References

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