A Controlled Experiment Investigation on the Impact of an Instructional Tool for Personalized Learning

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Abstract

This paper describes a controlled experiment concerning the use of a learning aid during the instructional procedure. The core issue of investigation is whether this instructional aid can augment the cognitive transfer of the learners by personalizing the offered knowledge. A controlled experiment was performed with the participation of 79 students. The results have shown that for the transfer of simple information this “lesson sheet” does not provide any statistically significant advantage, yet for complex information a statistically significant better performance is observed for the student group that used the tool.

1. Introduction

Most recent learning approaches adopt the student-centered approach, that is argued to be clear and understandable [4], responsive to the ways in which students learn and communicate [3], and acknowledges students’ interest and motivations [1]. It is also argued that some instructional aids can activate the participation of the learners and solve some of the problems of face to face instruction and of traditional printed material delivered to the learners [5]. So, the motivation of this study was the need to investigate a tool that could support the student during the lesson, providing him with the ability to personalize the offered knowledge, as well as after the lesson, namely during his study at home, serving thus in the framework of personalized learning. More precisely, this study investigates a «lesson sheet» for use during the live lessons, to aid the student in capturing the offered knowledge, as well as for use after the lesson to assist him in understanding and assimilating the taught material.

2. Description of the Experiment

2.1. The “Lesson Sheet”

A “lesson sheet” for use in the classroom during the instruction has been developed, as thoroughly described in [2]. It takes the shape of a table, divided in rows and columns, and contains in the left-hand column the outline of the lesson in the form of paragraphs. In the right-hand column it provides a variety of context-sensitive information, that could be a summary of the theme under consideration, charts and graphs, pictures or other material, related to the discussed issues.

A short description of the design principles and a set of construction guidelines of the sheets can also be found at http://aiges.csd.auth.gr/karoulis, in the «Lessons/ODL» sector, as well as a sample sheet that has been used during real lessons.

2.2. Methodology

During the experiment, 79 students of the department of informatics of the Aristotle University of Thessaloniki, divided randomly into two groups, control and treatment group, participated in a series of 3 sessions concerning the cognitive domain of Usability Engineering. The augmentation of the knowledge was the dependent variable measured for each participant through the obtained test score. The independent one was the use or not of the “lesson sheet”, a logical variable of type yes/no. Only the second student group was given the possibility to use the “lesson sheet” during the instructional procedure. The dependent variable could be registered through the scores acquired by the students in the test, right after the lesson sessions.

The hypotheses of this study are:

H0a: There is no significant augmentation of the acquired knowledge on the domain relying on the use of the sheet.

H1a: There is significant augmentation of the acquired knowledge on the domain relying on the use of the sheet.

3. Experimental Results

In order to compare the performance of the two groups in both question categories, we computed for each student an average score (SIMPLE) for the 8 "simple" questions and an average score (COMPLEX) for the 7 "complex" questions. In order to compare the performance of the two groups in both question categories, we computed for each student an average score (SIMPLE) for the 8 "simple" questions and an average score (COMPLEX) for the 7 "complex" questions. These scores were tested, separately
for each group, if they are approximately normally distributed by the Kolmogorov-Smirnov (K-S) test. The K-S test showed that the hypothesis of normality cannot be rejected in any case (significance: \( p = 0.274 \) and \( p = 0.984 \) for the control and treatment groups respectively for SIMPLE and \( p = 0.825 \) and \( p = 0.580 \) for COMPLEX).

Having confirmed the normality of the data, we used the Student's t-test to compare the mean values of the two scores between groups. Basic descriptive statistics and the significance of the t-tests are given below:

### Table 1.
Descriptive statistics of the two experiment groups

<table>
<thead>
<tr>
<th></th>
<th>SIMPLE</th>
<th></th>
<th>COMPLEX</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CONTROL</td>
<td>TREATMENT</td>
<td>CONTROL</td>
<td>TREATMENT</td>
</tr>
<tr>
<td>Mean</td>
<td>6.7063</td>
<td>6.4391</td>
<td>4.6893</td>
<td>6.2674</td>
</tr>
<tr>
<td>Std Dev.</td>
<td>1.99329</td>
<td>1.64609</td>
<td>1.93426</td>
<td>1.91696</td>
</tr>
<tr>
<td></td>
<td></td>
<td>p=0.519</td>
<td></td>
<td>p=0.001</td>
</tr>
</tbody>
</table>

It is clear that there is a statistically significant difference between the means of the two groups only for the score COMPLEX.

The non-parametric Mann-Whitney (M-W) test has also been used to compare the two groups. The test showed significant difference only for the score COMPLEX (\( p = 0.001 \)) and no difference for SIMPLE (\( p = 0.305 \)).

### 4. Discussion

Based on the aforementioned results, we argue that there is no significant improvement of the students’ performance for the “simple” kind of information. Although the statistical analysis did not provide any statistically significant difference between the groups, the control group performed slightly better. This can be interpreted only as an indication that this group could better personalize the offered information, by keeping notes on their own and not being framed by the depicted information on the tool.

On the other hand, a statistically significant performance of the treatment group has been observed. It seemed difficult to accurately denote “Complex” information during instruction by the students themselves and under time pressure, so the tool seems to provide fair support in this direction, by providing them with all the information that is too complex to be recorded manually and on time.

The stated hypotheses can now be answered. The first null hypothesis must be accepted, however, the second null hypothesis must be rejected and the alternative adopted instead, so there is significant augmentation of the acquired knowledge for complex information on the domain relying on the use of the lesson sheet.

### 5. Conclusion

Based on the aforementioned results, it can be concluded that the “lesson sheets” can provide a valuable instructional aid in cases of complex information, yet they can hinder the personalization of the offered knowledge in case of simple information, which the students should be allowed to adapt and transform to their own learning style and idiosyncrasy.

### 6. References


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