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Analysis of the effectiveness of teaching with the support of eLearning in the course of Principles of Management I - performance analysis

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Abstract

In the research project GACR 406/09/0669 "Evaluation of the benefits of modern technologies in the process of formation and development of competencies of students in higher education", a pedagogical experiment was conducted at the Faculty of Informatics and Management in the University of Hradec Králové, the aim was to determine whether appropriate use of eLearning in higher education, leads to comparable student performance in the field of cognitive learning. The research subject is a comparison between student performance achieved in the experimental group in the cognitive area, with the student performance obtained in the traditional full-time form of teaching in the course of Principles of Management I. The aim of this paper is to describe the experiment carried out (methodology) and the results which are focused on the comparison of the student performance participating in the experiment. Therefore, the sub-hypothesis will be verified: "Students in the experimental group will achieve a comparable performance in cognitive learning by the end of the experimental teaching as the students taught by the traditional full-time form of teaching."

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1. Introduction

Just as everything moves forward very quickly, so do methods and technologies used in education. One modern possibility is the use of eLearning. Although the term eLearning has existed for 10 years, its uniform definition in the Czech environment has not been stabilized yet. There have been many definitions since the historical definition from the Educational dictionary:

"The e-learning term is used in this form in English or translated into Czech (elektronické učení/vzdělávání). E-learning identifies various types of computer-aided learning, usually using modern technological means, CD-ROM. E-learning is expanding especially in the sphere of distance education and corporate training." (Prucha, 2003), or later pedagogical concept:

"E-learning can be understood as an educational process, using information and communication technologies to create training, to distribute learning content, communication between students and teachers and for management of studies." (Wagner, 2005)
E-learning courses are now primarily web applications, designed to enable distance form of education and also taking the required tests.

In the research project GACR 406/09/0669 "Evaluation of the benefits of modern technologies in the process of formation and development of competencies of students in higher education“ a pedagogical experiment was conducted at the Faculty of Informatics and Management in the University of Hradec Králové, the aim was to determine whether appropriate use of eLearning in higher education, leads to comparable student performance in the field of cognitive learning. The research subject is a comparison between student performance achieved in the experimental group in the cognitive area, with the student performance obtained in the traditional full-time form of teaching in the course of Principles of Management I.

The project provided the main hypothesis: "The proposed concept of university teaching of the subject Principles of Management I, implemented with the support of eLearning leads to achieve comparable student results, in comparison to the traditional full-time form of education." Due to quantitative confirmation of this major hypothesis, it was divided into sub-hypotheses.

The paper deals with comparison of the effectiveness of teaching with the support of eLearning to the effectiveness of traditional higher education in the course of Principles of Management I.

2. Objective and methodology of the research

The research subject is to compare the student performance achieved in the experimental group in the cognitive field with the student performance achieved by traditional full-time teaching in the Principles of Management I course.

The aim of this paper is to describe the experiment (methodology) carried out and the results which are focused on the comparison of the performance of students participating in the experiment. It will therefore be the verification of hypothesis: "Students in the experimental group achieved comparable performance in cognitive learning at the end of the experimental as students taught by traditional full-time form of teaching."

2.1. The research methodology

The research used the following methods:

- an experiment - the main method, educational tests - verification of the hypotheses, interview (to a limited extent), observation (to a limited extent), statistical methods of processing the research results.

A pedagogical experiment is a suitable method for comparing the effectiveness of two different systems of teaching.

In the organization of the experiment, one of the important conditions is that the experimental and control groups were equivalent as much as possible. The experimental group is a group of subjects in which an experimental change is applied, in our case it is a group of students that used eLearning in education. The control group is a group of subjects in which the experimental change is not applied, in our case the students that used traditional methods of education (full-time tuition).

When evaluating the effectiveness of teaching we will use educational tests, which play an important role here. Entrance test (pre-test) verifies that the initial knowledge is the same in both groups. Output test (post-test) measures, whether the experimental change - E-learning - had any impact on the student’s knowledge in comparison with traditional teaching. The essence of the experiment is captured by Figure 1.

2.2. Selection of the samples

In a typical school practice, a random selection into an experimental research is usually impossible. The available choice was used to select the research sample. The findings of the research can only be generalized to a limited extent, to the Faculty of Informatics and Management at the University of Hradec Králové and other faculties of Czech universities specializing in computer or economics science.
The research sample consisted of college students (University of Hradec Kralove, Faculty of Informatics and Management), who participated in the academic year 2009/10 in the course of Principles of Management I. This course is included as compulsory for subjects of Financial Management, Tourism Management, Information Management and Sports Management, in the study plan, the course is designed for the 1st year.

The experimental and control groups were created by random selection. At the Faculty of Informatics and Management at the University of Hradec Kralove, the students have the choice for inclusion in the exercises of the course.

The course Principles of Management I, includes two hours lecture and 1 hour of exercise a week in the case of traditional form of teaching. 14 exercises were included into the schedule for more than 300 students who included the course in their curriculum.

In the last week before the start of the semester, the students enrolled in one of the fourteen exercises offered, according to their timetable. Four exercises were chosen, which were included in the experiment (two experimental and two control exercises). Both forms of teaching were implemented by one teacher.

At the beginning of the experiment, the number of students in the experimental group was 35 and in the control group 37. Unfortunately, not all students took the post-test, because some students did not complete the course (they ended during the semester).

The resulting number of students who participated in the whole experiment was 32 in the experimental group and 34 in the control group.

2.3. Pedagogical experiment

In our described research, the independent variable is the eLearning form of education. The dependent variable in the experiment was the students' performance - remembering, understanding and application of new knowledge.

The research used an experimental plan using a pre-test and post-test.

The students’ knowledge level at the beginning of the experiment was identified by the pre-test, the post-test determined their level of knowledge at the end of the experimental operation. All educational tests which were used in the research, were designed for measurement of educational process outcomes in cognitive learning. When creating tasks in the didactic test, clearly defined objectives and an analysis of curriculum were determined.

For the design of test tasks in the framework of this research, Niemierk taxonomy was used, this type best suited the Principles of Management I course focus and the needs of generated teaching tests.

3. Research results - verifying the dynamics of growth in the performances

The processing of data was based on a database, which contains a detailed record of the results of each student. The data were processed by using statistical software NCSS2007.

3.1. Statistical description and analysis of the pre-test results

The test of input knowledge - pre-test - was created in order to determine the input level of knowledge before the experimental exposure. Because the Principles of Management I course is not attached to another course, so the text included only questions containing the substance of the course in Principles of Management I. A pre-test was necessary to verify that the input student's knowledge is equivalent, otherwise there would be no reason to implement this pedagogical experiment.

After initial processing of the pre-test, we obtained the following basic statistics, see Table 1. The chart 1 shows the student's performance (D is the experimental group and P is the control group).

| Table 1: Pre-test – the basic characteristics statistics |
|--------------------------------------------------------|
| The experimental group (D) | The control group (P) |
| Amount  | 35 | 37 |
| Average | 2,4 | 2,9 |
Distribution of student performance achieved in the entrance didactic test (pre-test) does not reject the normality and therefore for the further analysis inductive statistics (survey of statistical significance of differences) can be used.

To check the statistical equivalence of the samples with the indicators of pre-test results, an analysis of variance (the significance level of 0.05) was performed by the Student t-test. For reasons of not entirely clear distribution, a non-parametric Mann-Whitney test was also performed. The objective of this test was to verify the initial hypothesis $H_0$: There is no statistically significant difference between the initial test results for experimental and control groups.

Table critical value of the testing criteria - $T_{crit} = 1.9866$.
Calculated value of the testing criteria - $T_{calcul} = -1.2858$.
That is why $-1.2858 = T_{calcul} \leq T_{crit} = 1.9866$

is the accepted null hypothesis, therefore, in the pre-test there was no statistically significant difference (probability 95%) between performances of students enrolled in the experimental and control groups.

The validity of the null hypothesis is confirmed by the non-parametric Mann-Whitney test, which is appropriate to use in the case of ambiguous normal distribution.

The analysis showed that $H_0$ is confirmed - no statistically significant difference between levels of knowledge in pre-test of the experimental and control groups, so the groups can be considered as equivalent.

This finding entitled us to implement the educational experiment.

3.2. Statistical description and analysis of the post-test results

The test of output knowledge - post-test - was created in order to determine the output level of knowledge after the experimental exposure.

After initial processing of the post-test, we obtained the following basic statistics, see Table 2. The performance of students in post-test is also shown by Figure 1.

Table 2: Post-test – the basic characteristic statistics

|                   | The experimental group (D) | The control group (P) |
|-------------------|---------------------------|----------------------|
| Amount            | 32                        | 34                   |
| Average           | 9.2                       | 9.3                  |
| Standard deviation| 2.56                      | 2.48                 |
| MIN               | 0                         | 3                    |
| MAX               | 13                        | 14                   |
| Margin            | 13                        | 11                   |
| Mode              | -                         | 10                   |
| Median            | 9                         | 9.5                  |
To check the statistical equivalence of the samples with the indicators of post-test results, an analysis of variance (the significance level of 0.05) was performed by the Student t-test. For reasons of not entirely clear distribution, a non-parametric Mann-Whitney test was also performed. The objective of this test was to verify the hypothesis H₀:

*There is no statistically significant difference between the performances that were reached in the post-test (output diagnostic test) by the students classified in the control group and the students in the experimental group.*

Table critical value of the testing criteria - \( T_{\text{crit}} = 1.9866 \).
Calculated value of the testing criteria - \( T_{\text{calcul}} = -0.2314 \).

Since \(-0.2314 = T_{\text{calcul}} \leq T_{\text{crit}} = 1.9866\) is the accepted null hypothesis. Differences in student performance in the post-test for experimental and control groups were not statistically significant.

The validity of the null hypothesis is also confirmed by the non-parametric Mann-Whitney test.

Hypothesis H₀: *Students in the experimental group achieved comparable performance in cognitive learning at the end of the experimental teaching as students taught by a full-time form of teaching is confirmed.*

4. Conclusion

The results of the research presented above show, that students learning with the use of e-learning in the cognitive area achieve comparable results, with students taught by traditional full-time study. At the present time, the second running of the research is being implemented to confirm the results. If this conclusion is confirmed, it would definitely be interesting to use e-learning as a standard device in the education of university students.

Before the incorporation of e-learning in the process of education, the following aspects should be carefully considered:
- content of course - the appropriateness of learning by using e-learning and educational effectiveness;
- assumptions of educational institutions - ICT facilities, personnel ensure;
- assumptions of students - the ICT literacy, access to ICT;
- finally the economic aspect.

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