

# Blended Learning in Higher Public Administration Education: A Clustering Approach

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**Abstract**—In the paper, we present a study conducted at the Faculty of Administration (FA), a member of the University of Ljubljana, Slovenia, where a combination of traditional face-to-face (F2F) learning and e-learning, i.e. blended learning, is used in all undergraduate courses. In the questionnaire survey students are asked to express their opinions on this learning practice. Based on the collected opinions concerning blended learning students are grouped into four clusters using algorithm-means clustering. Two main characteristics that distinguish clusters are students' opinions on the usefulness of the e-learning and their satisfaction of working with a computer for study purposes. Focussed on the obtained clusters, students' demographic characteristics are used for further analysis among them. Consequently one interesting thing is detected, namely first-year students prefer e-learning while students in the last year of study favour traditional F2F approach. The results of the study can provide useful guidelines for the further development of blended learning in higher education institutions.

**Keywords**—blended learning, clustering, undergraduate students, public administration education.

## I. INTRODUCTION

We are living in an era of information society. Information and communications technology (ICT) is developing with great haste and is encountered in a wide variety of areas in our everyday life, and teaching and learning are no exception. For today's generations of students new technologies, such as smart phones and tablet PC, have become necessary in everyday life. On the other hand, some authors, such as Jones, Ramanau, Cross, and Healing (2010) and Kubiato (2013), pointed out that the way of functioning and thinking of young people is changing precisely because of the influence of smart devices with which they are surrounded. Because of this, teachers are in some way forced to use ICT in learning process if they want to move toward the new generations of students. Talking about e-learning we have in mind internet-based ICT to deliver teaching and learning without limits regarding the place and

time. Combination of traditional face-to-face learning and e-learning, i.e. blended learning, is becoming increasingly widespread at all levels of education as well as in higher education. Online courses offer different opportunities for adapting learning materials and assignments to the individual student's needs, abilities and learning approaches, and, which is especially favorable in today's fast pace of life, independency of time and space.

A combination of traditional and online learning integrates the positive features of both methods to enhance students' learning experience [3]. For the education institution, the goal of introduction blended learning has to be effective and beneficial for all involved stakeholders – students, teachers, and administrations. However, measuring the quality and performance of blended learning experience is not an easy task. One aspect is, of course, technology, while the other one is pedagogical and they both together form the quality of learning. Ginns and Ellis (2007) noted the need for a sensitive research methodology which could identify the correlation between the use of technology and the quality of learning.

The usability and acceptability of the system from the user perspective are therefore an essential value of the success of the learning management system, LMS [5]. Since the students are the main end-users of the learning process and their final successes is one of the criteria of the system's effectiveness, the students' opinions are important [6]. For the participant in learning process, the experience needs to be satisfactory, if we want that the student takes full advantage of the learning system [7]. Therefore, students should be regularly asked to give the opinions on the work for study purposes in online environment.

Many factors may affect the student's perception of comfort and positive experience in online environment in blended learning, among them LMS characteristics, student experience with ITK, student's individual characteristics etc. We can reasonably expect that the inclination of students to blended learning is different. The main research questions motivated the study were:

- 1) Can students be divided into "natural" groups according to their attitude towards blended learning?"
- 2) Whether the students in the identified group also have similar demographic characteristics?

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## II. DATA AND RESEARCH METHOD

A research to be presented below was conducted among students of the FA, University of Ljubljana, Slovenia. The FA offers two undergraduate 1<sup>st</sup> cycle study programmes: University Study Programme in Public Sector Governance and Higher Education Professional Study Programme in Administration. Both programmes are provided in a combination of F2F teaching in the classroom and e-learning, where LMS Moodle has been used since 2009 as the platform for blended learning [8]. Once a semester we ask our students to evaluate several aspects of e-courses in which they are enrolled.

### A. Data Sample

In our study, we investigated the students' attitudes towards blended learning in general, i.e. not focussing on the particular e-course. Therefore, we used just a part of the questionnaire survey, namely the first part where students' attitudes to e-learning are measured. Students evaluate their level of agreement with each aspect on a scale ranging from 1 ("disagree very strongly") to 7 ("agree very strongly"). Students can also choose N ("do not know") or even to not respond at all since survey participation is not obligatory. Table 1 summarizes those seven aspects of blended learning we used in our study presented here.

TABLE I: ASPECTS OF BLENDED LEARNING

Abb.	Aspect of Blended Learning
A1	Working with computers for study purposes suits me.
A2	The Moodle e-learning system is easy to use.
A3	The Moodle system is reliable and stable (it does not crash, submitted tasks are not lost).
A4	I am satisfied with the support and assistance in the event of technical problems.
A5	Working with computers for study purposes is difficult for me.
A6	E-learning contributes to higher student academic performance.
A7	E-learning is not a quality replacement for traditional learning in the classroom.

Our population of interest was undergraduate full-time students answering the questionnaire in the period 2014/15 to 2016/17 academic years. The final data set included 706 records, each representing opinions of one student in one academic year.

Additionally, we integrated record with student's demographic data, namely gender, year of study, study programme, and average grade for all passed exams of the particular student.

### B. Method

To explore the structure of our sample we performed hierarchical clustering algorithm in order to find groups of students with similar opinion on blended learning. We computed the dissimilarity between two records with Euclidean distance. We further used Ward's method linkage to measure the dissimilarity between clusters.

Based on the inspection of the hierarchical clustering tree we determined the appropriate number of clusters. We used

the inspected number further for the k-means clustering for partitioning our sample to disjoint clusters.

We computed mean values for all 7 aspects (A1–A7) inside each cluster, which enabled us describing the cluster. Further, we used the statistical tests to investigate if the membership of a cluster is related to demographic data: chi-squared test for investigating connectivity with gender, year of study and study programme; and analysis of variance (ANOVA) for investigating the relationship with the average grade.

## III. RESULTS AND DISCUSSION

As a results of clustering process we identified four clusters grouping students with similar aspects of blended learning. The Table 2 represents the average level of agreement for all seven statements among all clusters. Bolded value represent the outstanding values of the individual cluster, which at the same time determine the characteristics of students, members of the cluster.

TABLE II: CLUSTER SIZES AND AVERAGE VALUES OF ASPECTS

Cluster	Size	Average Level of Agreement						
		A1	A2	A3	A4	A5	A6	A7
Cluster 1	123 (17 %)	<b>3.99</b>	<b>3.84</b>	<b>4.02</b>	<b>3.81</b>	3.85	<b>3.36</b>	3.95
Cluster 2	186 (26 %)	5.51	5.91	<b>6.02</b>	<b>5.88</b>	<b>5.45</b>	5.26	4.64
Cluster 3	174 (25 %)	<b>5.98</b>	<b>6.09</b>	<b>5.65</b>	<b>5.51</b>	1.82	4.41	<b>5.12</b>
Cluster 4	223 (35 %)	<b>6.38</b>	<b>6.23</b>	6.01	5.86	1.69	<b>5.90</b>	1.91
Total	706	5.63	5.70	5.58	5.42	3.09	4.92	3.78

The Cluster 1 consists of 123 students, which represents 17 % of the whole sample, and in this respect is the smallest among all four clusters. The average values of aspects A1–A4 and A6 are the smallest in comparison to the other clusters. That means that the Cluster 1 consists of the students who are the least satisfied with the e-learning (compared to other clusters).

The Cluster 2 consists of 186 students which represents 26 % of the whole sample. The average values of variables A3 – A5 are the highest in comparison to the other clusters. Therefore, the Cluster 2 consists of the students who find the Moodle learning system stable and are satisfied with the technical support. On the other side, they have the most difficulties (aspect A5) working with computers for study purposes. Perhaps we may conclude that this is the reason why they were so satisfied with the technical support since they had the most experiences with them.

The Cluster 3 consists of 174 students which represents 25 % of the whole sample. Although the mean values of variables A1 – A4 are pretty high, the result that stands out is the highest mean value of the aspect A7. That characterizes a cluster of students who like e-learning but do not consider it as a quality replacement for traditional learning in the classroom.

The Cluster 4 is the largest one – it consists of 223 students which represents 35 % of the whole sample. The mean values of aspects A1, A2 and A6 are the highest compared to the other clusters, mean values of aspect A5 and A7 are the lowest. This cluster consist of the students who really like e-

learning: they like working with computers for study purposes, they think that e-learning contributes to higher student academic performance and is a quality replacement for traditional learning in the classroom. Besides that, they find it easy to use and have less difficulties in working with computers.

To describe the clusters from another perspective we investigated if the cluster membership is related to demographic data we collected (gender, year of study, study programme, average grade). Using chi-squared test for gender, year of study and study programme; and ANOVA for the average grade, we report p-values in the Table 3.

TABLE III: P-VALUES FOR ASSOCIATION BETWEEN DEMOGRAPHIC VARIABLES AND CLUSTER MEMBERSHIP

Variable	Gender	Year of Study	Study Programme	Average Grade
Sig.	0.464	0.00005	0.148	0.001

From the Table 3 we see that the cluster membership is not significantly related to gender and study programme, but it has a significant association with the year of study and the average grade.

The contingency table (Table 4) shows the relationship between cluster membership and the year of study. The bolded frequencies contribute most to the strong association between the cluster membership and the year of study.

TABLE IV: CONTINGENCY TABLE: CLUSTER MEMBERSHIP AND YEAR OF STUDY

	Year of Study			Total
	1st	2nd	3rd	
Cluster 1	57	<b>52</b>	14	123
Cluster 2	<b>117</b>	51	<b>18</b>	186
Cluster 3	79	58	<b>37</b>	174
Cluster 4	121	60	42	223
Total	374	221	111	706

The contingency table characterizes all years of study in terms of cluster membership. From the expected count table and the table with contributions to chi-squared statistics (the tables are skipped from the paper due to clarity) we can deduce that the first year of study is overrepresented (there are more students from the first year of study in the Cluster 2 as expected) in the Cluster 2. These are the students who find the Moodle learning system stable and are satisfied with the technical support. On the other side, they have the most difficulties with working with computers for study purposes.

The second year of study is overrepresented in the Cluster 1. These are the students who are the least satisfied with the e-learning.

The third year of study is underrepresented in the Cluster 2 and overrepresented in the Cluster 3. The results show that the students in the last year of study have less problems with working with computers and more consider e-learning but as a quality replacement for traditional learning in the classroom.

It is interesting, that the Cluster 4 which consists of the students who really like e-learning is not characteristic for any particular year of study.

The average grade was the other variable which resulted in significant association with the cluster membership. ANOVA (see Table 4) showed significant differences among the clusters in terms of the average grades. The average grades among the clusters are shown in Table 5.

TABLE V: AVERAGE GRADES AMONG THE CLUSTERS.

Cluster	Average Grade
Cluster 1	7.25
Cluster 2	7.05
Cluster 3	7.44
Cluster 4	7.32
Total	7.26

The average grade is the lowest (7.05) in the Cluster 2 which consists of the students who find the Moodle e-learning system stable and are satisfied with the technical support but have the most difficulties with working with computers for study purposes.

On the other side, the average grade is the highest (7.44) in the Cluster 3, which is consist of the students who like e-learning but do not consider it as a quality replacement for traditional learning in the classroom.

Using the LSD (Least Significant Difference post-hoc test) we further discovered that Clusters 2 and Cluster 3 and clusters 2 and 4 significantly differ in terms of the average grades.

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