Analysis of Selected Aspects of Students' Performance and Satisfaction in a Moodle-Based E-Learning System Environment

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The use of e-learning techniques in higher education is becoming ever more frequent. In some institutions, e-learning has completely replaced the traditional teaching methods, while in others it supplements classical courses. The paper presents a study conducted in a member institution of the University of Ljubljana that provides public administration programmes. We analysed the relationship between the proportion of the course implemented in the Moodle e-learning platform and students' performance on one hand and their satisfaction on the other. The empirical findings reveal a positive correlation for both elements. The results can help decision-makers learn more about how to enhance students' success and satisfaction using an e-learning platform.

Keywords: blended learning, e-learning, learning effectiveness, Moodle learning management system, public administration higher education, students' performance, students' satisfaction

INTRODUCTION

E-learning is becoming increasingly interesting for society and educational institutions because it supports the concept of lifelong learning and because knowledge is becoming more and more important. This increases the demand for various educational forms and means. Different education programmes around the world cater to this increased demand and offer new forms of education that are frequently supported by information and communication technology (ICT) (Sulčič & Lesjak, 2009). Moreover, technological advances have revolutionized teaching and learning processes (Aristovnik, 2012, 2014). Fry (2001), for instance, notes that the emergence of new technologies, the rapid expiration of knowledge and training, the necessity of just-in-time information delivery, and the need for more cost-effective teaching methods have transformed teaching and learning practices. In the future, as Baris (2015) pointed out from the recent research, e learning will become absolutely

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necessary in education process as blended learning, where traditional learning will have only a supporting role. The information era has influenced also the public administration and many researchers believe that the digital communication and distance learning (as a part of lifelong learning) are basic competencies for public administrators (Liu &Yen, 2014). Therefore, e-learning as a part of pedagogical process in the public administration courses is almost indispensable.

The purpose of the paper is first to provide an answer to the question of whether the introduction of the Moodle e-learning system as part of the teaching process in the public administration programmes had an impact on the students' effectiveness as one aspect of their performance, measured as the average grade and average number of admissions to the exams for each course (in the continuation the term effectiveness will be used). Second, we tried to find out how introduction of the e-learning system influenced the students' satisfaction with specific aspects of the way the course was conducted (satisfaction with the possibility of a prompt study, satisfaction with the availability of relevant information).

The paper proceeds with literature review, then continues by presenting the sample and the data collected, followed by a description of the methodology and empirical results. The conclusion offers the findings, implications for research and practice, as well as limitations and avenues for future research.

State of the literature

- In last decades e-learning is becoming increasingly interesting for society and educational institutions because it supports the concept of lifelong learning.
- In higher education, the use of e-learning platforms is becoming ever more frequent. In some cases, it has completely replaced the traditional teaching methods, while in others it supplements classical courses.
- Besides the many advantages of blended learning, there are also many disadvantages, which can decrease the positive impact of modern information communication technology on students' performance. It is therefore important to analyse the opinions of different stakeholders involved in the e-learning process, i.e. lecturers and students.

Contribution of this paper to the literature

- Students' effectiveness and satisfaction increase when a bigger proportion of a course is carried out using Moodle.
- The results can help decision-makers to learn more about the influence of using an e-learning platform on students' success and satisfaction.
- The results of the study provide an important foundation when deciding on the future development of e-learning at the University of Ljubljana.

LITERATURE REVIEW

Many different terms are used to describe e-learning, such as distance learning, internet learning or on-line learning, where teaching and learning process occur on computers connected to the internet. The benefits of e-learning are mainly learning independently of time and place, reducing geographical barriers as well as travel and programme overhead costs, where each individual can study the material at their own pace (Cole, 2000; Novo-Corti et al., 2013). But besides the many advantages of this type of study, there are also many disadvantages which can decrease the positive impact of modern ICT tools on students' performance (e.g. in Wang et al., 2003). Moreover, in the e-learning process there are also many specific factors involved (Chien, 2012; Frydrychova Klimova & Poulova, 2013; Haverila & Barkhi, 2009; Kim & Kim, 2013; Ozkan & Koseler, 2009; Park & Choi, 2009; Saba, 2012; Upadhyaya & Mallik, 2013) that are not directly connected with the ICT but importantly influence the students' performance (Lopez-Perez et al., 2011), sometimes also in a negative way (Berge & Huang, 2004; Frankola, 2001; Willging & Johnson, 2004).

A promising teaching principle in higher education is the concept of combining traditional face-to-face teaching and e-learning, called blended learning. When making decisions regarding the introduction of blended learning (Friesen, 2012) and on the use of a specific e-learning platform, it is important to analyse the

opinions of different stakeholders involved in the e-learning process, i.e. teachers (Boling et al., 2012) and students (Ozkan & Koseler, 2009; Paechter et al., 2010; Wu et al., 2010). They have different knowledge, abilities, expectations and needs and therefore various aspects should be considered (Campanella et al., 2008). Graham, Woodfield and Harrison (2013) defined three stages of development from traditional to blending learning that can help institutions design implementation of blended learning, i.e. (1) awareness and exploration, (2) adoption and early implementation and (3) mature implementation and growth. The survey pointed out that institutions must strongly support the introduction of blended learning with policy and support structures, as it is the only way to be expected to be beneficial for institution, teachers and students. This is also important when making improvements and deciding about any changes in the concept of e-learning.

One of the fastest growing software programs is learning management system, which manages courses, tracks students' progress, offers self-evaluation tests, supports teaching and learning process, and enables communication. One of the most popular is the open-source learning management system Moodle, already widespread in all segments of education. System is very flexible, adaptable and contains many standard features, which make it popular. LMS Moodle has found its place also in higher education. In the research exploring e-learning platforms used in Italian universities (Campanella et al., 2008), Moodle was placed in a group of the most valuable platforms. Kareal and Klema (2006) compared particular features of some open-source e-learning systems and concluded that Moodle is one of the most adaptable, which is an essential part of effective education as they pointed out, and most user-friendly learning systems among all the compared ones. Liao et al. (2011) studied the implementation of a Moodle course in blended learning at a university and found that for students Moodle e-learning platform is easy to use and provides a good communication tool for cooperative learning in groups. They conclude that Moodle e-learning platform could improve the quality of student learning.

Since e-learning has been an important and ever more frequently used teaching technique in the past few decades, there are many opinions as well as studies on its impact on students' performance. Delivering instructions that can produce equal or even better outcomes than face-to-face learning systems is one of the main goals of introducing ICT into study process (Carr, 2000; Saba, 2012).

Psycharis et al. (2013) studied how the introduction of Moodle increased the conception of fundamental issues in secondary school physics. They noticed a slight improvement in performance and positive students' attitude towards the model of blended learning using Moodle. Galy et al. (2011) reviewed the relevant literature on students' performance measured by final course grade and summarized that many didn't find the difference between students involving in traditional pedagogical process and those in e-learning to be statistically significant. In their own research, they determined statistically significant factors of the e-learning tools that influence on final grade: usefulness, ease of use and ability of student to work independently. They also found statistically significant difference in the final grade.

PRESENTATION OF THE INSTITUTION

The Faculty of Administration (FA) is part of the University of Ljubljana, Slovenia. The FA educates students in the field of administrative science and develops this field through a variety of research. Study at the FA is interdisciplinary and includes administrative, legal, economic as well as organizational and ICT courses. The FA offers two undergraduate study programmes (1st cycle) – University Study Programme in Public Sector Governance along with a Higher Education Professional Study Programme in Administration, which last 3 years (six semesters). Both

undergraduate study programmes of the FA meet the high quality standards defined by the European Association for Public Administration Accreditation (EAPAA).

E-Learning at the FA

The beginnings of e learning at the FA date back to 2005 when we implemented a payable platform for e learning, i.e. eCampus. After three years of use, the learning platform was replaced with open-source Moodle platform, mainly due to the user-friendly environment and cost benefits. The FA offers blended learning where traditional face-to-face teaching is combined with e-courses in Moodle.

At the beginning, the implementation of an e-course was based on the voluntary decision of the teachers themselves. In the 2010/11 academic year, blended learning became mandatory for all courses of the first year of undergraduate study, namely 20% to 30% of the traditional face-to-face learning process of each course was implemented in Moodle. In the next year, blended learning was implemented in the first and second years of undergraduate study and in the 2012/13 academic year, all courses of the first cycle had their own e-classroom in Moodle. At the same time, the rules that control the quality performance of the educational process in an e-course (e-learning policies) were set. In accordance with these rules, any e-course has to include at least:

- An introductory section with basic information about the course and students' obligations;
- Two forums: a news forum and a discussion forum – for communication between lecturers and students;
- E-content – additional learning resources for independent online study;
- Self-evaluation activities for students (e.g. quizzes); and
- Assignments for students, where lecturers' feedback about the correctness is mandatory.

At the end of each semester, the coordinator for e-learning reviews the adequacy of e-courses according to the rules. The quality of the pedagogical work in e-courses is thus regularly monitored and the necessary improvements are implemented in the next academic year.

METHODOLOGY

Research hypotheses

Student satisfaction surveys are common to all faculty members of the University of Ljubljana and form part of the regular annual monitoring of the quality of the FA. In the survey, students express their individual opinions regarding the quality of the execution of specific subjects and of the pedagogical work of participating lecturers. Filling in the survey through a web-based information system is anonymous and secured by a specific IT solution. The survey results are used as a basis for carrying out habilitation procedures and give feedback to lecturers about their lectures and teaching methods during the year.

Answers to a question range from minus 3 (very bad) and minus 1 (negative) to 1 (good) and 3 (very good). Students can also choose N ("do not know") or even do not respond at all since participation in the survey is not obligatory. Missing responses and the value of N in the survey analysis are considered as missing values.

We selected the following two questions from the student survey about execution of the course that relate to our study.

Q1: The knowledge gained in each lesson is regularly checked during the semester.

Q2: Timely relevant information about the course and related duties is available.

In the first question, students are asked whether they are satisfied with the possibility of studying the course material promptly in any form. This means, that besides the possibility of partial exams during the semester, different assignments and quizzes are offered, with all being available in the Moodle platform. Students are therefore "forced" to study in shorter time intervals, not only at the end of a semester. The second question asked students how satisfied they are with the availability of relevant information related to the course. The Moodle platform allows simple communication between lecturers and students via several forums from which students are directly sent instant notifications about relevant topics to their e-mail addresses.

The two research questions were formulated as hypotheses:

H1: Students' effectiveness is increased when a bigger proportion of a course is carried out using Moodle.

H2: Students' satisfaction is increased when a bigger proportion of a course is carried out using Moodle.

Sample

Due to the heterogeneity of the courses at the FA we focused on the obligatory courses in the first year of study and excluded outliers with too high and too low average grades. The final study included 13 courses and five of their properties (the proportion of time the course was held in Moodle, the average grade and the number of admissions to the exams, satisfaction with a prompt study and the availability of relevant information). The total number of students from which the aggregation averages were computed was 205. The data were collected in the 2012/13 academic year.

Table 1 shows the basic statistical properties of the analysed data. It represents the means and standard deviations for all analysed variables and provides information about the source from which we computed the descriptive statistics. We used three different data sources for our analysis: e-classroom evaluation (from which we estimated the proportion of time spent in Moodle); the exam database (for the average grade and required number of admissions); and the student survey (for Q1 and Q2). Due to the anonymity of the student survey, we were unable to link the three sources so we had to merge all information at the level of courses. For each course analysed we computed its average passing grade (measured from 1 to 10, students pass an exam with a grade of 6 or higher), the required number of admissions, satisfaction with a prompt study (Q1) and the availability of relevant information (Q2), ranging from −3 to 3.

Methods

In the empirical study, we analysed the statistical relationship between the proportion of the course implemented in the Moodle e-learning platform and two

Table 1. Descriptive statistics for the analysed variables

Variable	Range of values	Mean	Std. dev.	Source	Number of units
Proportion in Moodle	20% – 33%	0.2	0.05	e-classroom evaluation	13
Average grade	6 to 10	7.12	1.12	exam database	1061
Number of admissions	> 0	1.25	0.6	exam database	1061
Q1	−3 to 3	1.29	1.45	student survey	973
Q2	−3 to 3	1.79	1.23	student survey	973
Number of students		81.62	37.43	e-classroom evaluation	13

Source: Survey, 2015

aspects of students' effectiveness as well as two aspects of students' satisfaction. We measured the effectiveness with the average grades and average number of admissions to exams. Satisfaction was measured with students' opinion on the possibilities of a prompt study (Q1) and the availability of the course-relevant information (Q2). A graphic estimation of the statistical relationship was made with four scatter plots. We presented two variables, which measure effectiveness in one figure, and two variables that measure satisfaction in another as a function of the proportion of the course implemented in Moodle.

We also computed the weighted Pearson correlation coefficient between the proportion of the course implemented in Moodle and all other analysed variables. Like the traditional coefficient, its weighted version ranges from −1 to 1, where 1 corresponds to a perfect positive correlation, −1 to a perfect negative correlation and values around 0 indicate no linear relationship. We used the weighted coefficient to incorporate different numbers of students who attended different courses. Besides the weighted Pearson coefficient of correlation, we computed its standard error, t-statistics and corresponding p-value that helped us test our research hypotheses. In order to test the robustness of the obtained results we used Bootstrapping method and reported the lower and upper bounds for 90 % confidence intervals. We used 10,000 bootstrap samples and estimated the bounds of the intervals using percentile method (Efron, 1987).

EMPIRICAL RESULTS

In order to graphically estimate the statistical relationship we plotted four scatter plots: the x-axis represents the proportion of the course implemented in Moodle in all four plots. The y-axis represents a different variable in each scatter plot. For descriptive purposes, we coloured the points with two colours: the black dots represent courses from the university study programme, while the grey dots represent courses from the professional study programme. The size of a dot is proportional to the number of students who attended the course (see Figure 1 and Figure 2).

The scatter plots in Figure 1 represent the relationship between the proportion of a course implemented in Moodle and the two aspects of students' effectiveness –
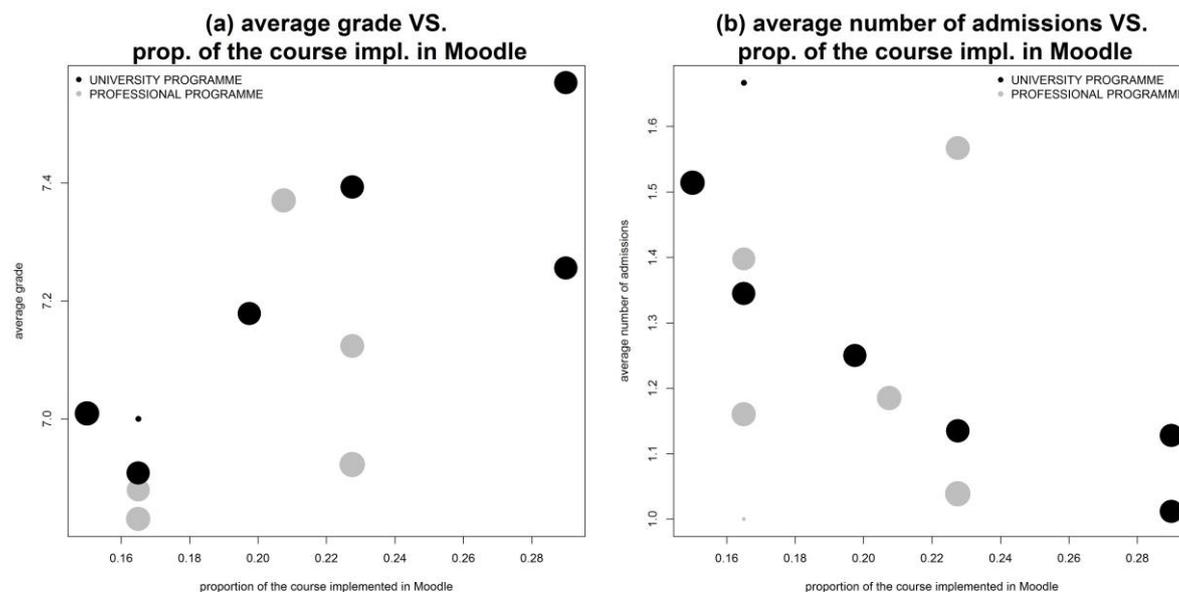

Figure 1. Relationship between the proportion of the course implemented in Moodle and the average grade (plot a) and the number of admissions to exams (plot b)
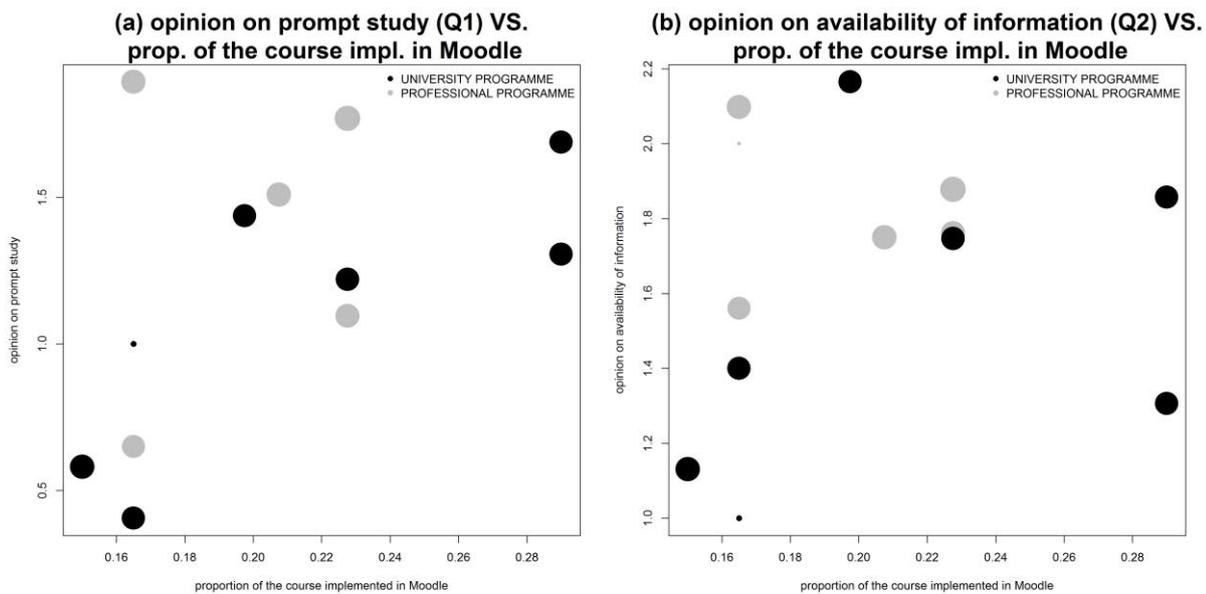
Figure 2. Relationship between the proportion of the course implemented in Moodle and satisfaction with the possibilities of a prompt study (plot a) and with the availability of information (plot b)

the average grade and the average number of admissions to the exams. The scatter plots show that the implementation of Moodle has a positive impact on students' effectiveness: in courses where Moodle is implemented to a smaller degree (16% or less) students received on average lower average grades (below 7 on a 1–10 scale) and those courses on average require more admissions (around 1.4) to pass an exam. In the courses with a higher proportion of Moodle (around 30%), students on average received better grades (around 7.3) and only required a little more than one admission to pass an exam (around 1.05). The relationship is stronger for the courses from the university study programme (black dots).

The scatter plots in Figure 2 show that the proportion of the course implementation of Moodle has a weaker impact on students' satisfaction. For courses where Moodle is implemented to a smaller extent (16% or less), students' satisfaction with the possibility of a prompt study is lower (the average mark is below 1 on a −3 to 3 scale) than for the courses where Moodle is implemented to a bigger extent (average satisfaction above 1). Yet, on the other hand, there seems to be no such relationship for satisfaction with the availability of relevant information. Perhaps the main reason is that the students' opinion on this question (Q2) shows that the general availability of important information at the faculty level is relatively high (an average of around 1.7 on a scale from −3 to 3).

To test hypotheses H1 and H2 we computed the weighted Pearson correlation coefficient and estimated the 1-sided p-values between the proportion of a course implemented in the Moodle e-learning platform and the two aspects of students' effectiveness (average grade and average number of admissions) and the two aspects of students' satisfaction (Q1, Q2). Table 2 shows the results of our empirical study.

The empirical study showed that the proportion of a course implemented in the Moodle e-learning platform is strongly and positively correlated (r = 0.70) to the average grade – the weighted Pearson correlation is highly significant (p-value: 0.004, 90% confidence interval (CI): 0.48 to 0.91, see Table 2). This means that in those courses with a higher proportion of workload in Moodle students tend to receive higher average grades compared to the courses with a lower proportion. On the contrary, the correlation with the average number of admissions to the exams is moderate and negative (−0.56) and still significant (p-value: 0.024, CI: −0.79 to

Table 2. Weighted Pearson correlation coefficient and related statistics

Variable	Correlation	Std. err.	t-value	90 % bootstrap CI		p-value (1-tailed)	
				low. bnd.	upp. bnd.		
Average grade	0.70	0.22	3.22	0.48	0.91	0.004	***
Average number of admissions	−0.56	0.25	−2.23	−0.79	−0.05	0.024	**
Q1	0.48	0.26	1.81	0.13	0.83	0.049	**
Q2	0.14	0.30	0.47	−0.39	0.61	0.323	

The correlation is significant at the following levels: 0.1 (*), 0.05 (**), 0.01 (***)
Source: Survey, 2015

−0.05). This means that students in the courses entailing a higher proportion of Moodle on average require fewer admissions to the exams compared to the courses where the proportion is lower. The empirical results thus support our first hypothesis (H1) and show that students' effectiveness is increased (better average grade, fewer admissions to the exams) when a bigger proportion of a course is carried out using Moodle. These results are in line with some previous empirical research demonstrating that Moodle positively affects students' performance (see for instance Lopez-Perez et al., 2011; Psycharis et al., 2013). The bootstrapping procedure for estimating confidence intervals (CI) showed that neither of two CIs contain 0. This supports hypothesis H1 from a different perspective showing the robustness of the methodology used. Although the CIs for weighted correlation are quite wide due to the very small sample size, the bootstrapping procedure still confirms the H1.

The weighted Pearson correlation coefficient shows a weaker relationship between the proportion of a course implemented in the Moodle e-learning platform and the two aspects of students' satisfaction, although the correlations are still positive and one of them significant at the 5% level (see Table 2). We found a modest positive correlation between the proportion of a course in Moodle and the students' satisfaction with the possibilities of a prompt study (r = 0.48), which is significant (p-value 0.049, CI: 0.13 to 0.83). This means that the Moodle environment enables students to study the course material promptly. Although the correlation between the proportion of a course implemented in the Moodle e-learning platform and satisfaction with the availability of information regarding the course is positive (r = 0.14), the value is too low to be significantly greater than 0 (p-value of 0.323, CI: −0.39 to 0.61). The results using bootstrapping procedure are entirely consistent with the computed p-values. Two procedures thus partially support H2 and show the robustness of computed weighted correlations.

The empirical results therefore only partially support our second hypothesis (H2). They show that students' satisfaction with the possibility of studying the course material promptly is increased when a bigger proportion of a course is carried out using Moodle but do not provide enough statistical evidence to prove the same relationship with the availability of course-relevant information. Nevertheless, these findings to some extent confirm similar empirical studies, such as Paechter et al. (2010), Wu et al. (2010) and Novo-Corti et al. (2013).

CONCLUSIONS

The results of our study indicate that the implementation of blended learning with a LMS platform Moodle at the Faculty of Administration, University of Ljubljana resulted in a statistically significant increase in students' effectiveness, measured by the average grade and the average number of admissions to the exams. We

confirmed our first research hypothesis (H1) that students' effectiveness is increased when a bigger proportion of a course is carried out using Moodle, i.e. students on average receive better grades and require fewer admissions to pass the exam. We partially confirmed our second research hypothesis (H2) that students' satisfaction is increased when a bigger proportion of a course is carried out using Moodle: we showed its positive impact on satisfaction with the possibility of studying the course material promptly but did not find enough statistical evidence to show its impact on satisfaction with the availability of relevant information.

The main limitation of the research was the limited data set. Due to the anonymity of the student survey, we were unable to link the students' answers to their grades. We therefore had to aggregate the data and analysed the courses as units of observation. Such aggregation reduced the sample size, blurred possible relevant relationships and made the estimated confidence intervals quite wide. Besides that, the courses at the FA are very diverse and we thus had to limit our survey to just the first year of study with the highest number of students and the most homogeneous subgroup of courses in terms of Moodle usage. The other limitation was hidden in the student survey where the focus is on the evaluation of lecturers and courses while no questions in the survey directly measure satisfaction with blended learning and its implementation with the Moodle e-learning system.

The students' performance and satisfaction are complex concepts that are influenced by several factors (students' motivation, quality of the content etc.) that our survey could not control. Although the current results indicate the positive effects of Moodle implementation the impact cannot be assigned to Moodle alone. The future research will try to fill the gap by measuring other possible influencing factors and extracting the relevant ones.

To conclude, the results of the study can still provide important background material when deciding on the future development of e-learning at the Faculty of Administration. Our future work will concentrate on introduction of another survey, which will be focused on students' and lecturers' evaluation of the Moodle environment and link the students' answers to their effectiveness. The results of our future surveys will provide a greater insight into the relationships we studied in this paper.

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