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Article in *International Journal of Innovation and Learning* · January 2017

DOI: 10.1504/IJIL.2017.10002132

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An assessment of the effectiveness of Moodle e-learning system for undergraduate public administration education

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Abstract: The use of information and communication technologies (ICT) and therefore e-learning is becoming an ever more frequently used teaching and learning technique at all levels of education. The purpose of the paper is to analyse how introduction of Moodle e-learning platform as part of the teaching process is related with students' performance, i.e., the average grade and the average number of admissions to the exams. We also examined the same relationship among different groups of students (based on selected individual socio-demographic factors). The study included a member of the University of Ljubljana (Faculty of Public Administration) in the period from 2008 till 2014. The results of the analysis (using a t-test) show a significant improvement in performance at the different (faculty-, student- and course-) levels after introducing the Moodle. The data show that the greatest improvement is seen among students with lower high school grades.

Keywords: e-learning; Moodle; blended learning; students' performance; average grade; average number of admissions; higher education; public administration program.

Reference to this paper should be made as follows: Umek, L., Keržič, D., Aristovnik, A. and Tomažević, N. (2017) 'An assessment of the effectiveness of Moodle e-learning system for undergraduate public administration education', *Int. J. Innovation and Learning*, Vol. 21, No. 2, pp.165–177.

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This paper is a revised and expanded version of a paper entitled 'Moodle e-learning system and students' performance in higher education: the case of public administration programmes' presented at the Multi Conference on Computer Science and Information Systems (MCCSIS 2015), Las Palmas de Gran Canaria, Spain, 21–24 July 2015.

1 Introduction

In recent years, e-learning has been becoming increasingly interesting for society and educational institutions because it supports the concept of lifelong learning and since knowledge is becoming more and more important. This increases the demand for various educational forms and means. Different education programs 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 and Lesjak, 2009). Moreover, technological advances have revolutionised teaching and learning processes (Aristovnik, 2012). 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-learning practices.

In comparison to traditional classroom instruction, the major advantages of e-learning are reducing geographical barriers as well as travel and program overhead costs. E-learning therefore adapts the time and space of the study process. The access becomes more flexible, from anywhere and usually at any time – essentially, it allows participants

to collapse time and space (Cole, 2000) – however, the learning materials must be designed properly to engage the learner and promote learning. On the other hand, there are also many problems that make e-learning ineffective. Many students drop out of online courses due to a lack of motivation, instructional design-related factors and learning style mismatch, time conflicts with other commitments, organisational support and follow-up on completion (Wang et al., 2003). Other problems connected with e-learning are the absence of significant differences in acquired knowledge, the unsuccessfulness of e-learning projects and inappropriate attitude of instructors (Sulčić and Lesjak, 2009; Selim and Chiravuri, 2015).

The effectiveness of e-learning systems has been an important subject of research in the last few decades see (Li, 2013; Fayyoubi et al., 2015). The opinions on the effectiveness of e-learning are many and very different. There are also many factors that influence the effectiveness of e-learning, with some being connected with technology/techniques and others with people. Upadhyaya and Mallik (2013) claim that each issue of the effectiveness of e-learning cannot be treated as a standalone topic – either as a technical matter or as a people issue. E-learning involves interaction between people and processes, meaning that has to be treated as a socio-technical system rather than a social system considering only the people aspect (e.g., students, teachers and other stakeholders) or a technical system only considering the standards and processes aspect [e.g., course content, technology, learning management system (LMS), content management tools]. E-learning is a complex process that depends not only on these aspects in isolation, but also the interaction among them.

The purpose of the paper is to analyse how the introduction of the Moodle e-learning system as part of the teaching process is related to students' performance in the public administration programs, measured as the average grade and the average number of admissions to the exams for each course. We also examined the same relationship among different groups of students (based on gender, country region, high school grades) and courses (year of study, study program, chair (faculty's organisational unit) in which the course is conducted). The study included data for the period from 2008 till 2014. The paper explains how introduction of the Moodle e-learning system increased the students' performance on the faculty level and discusses the variances among the different subgroups.

The paper is structured as follows: first, a brief literature review about e-learning and its impact on students' performance is presented. Second, we review the empirical methodology and describe the data. The third section outlines the empirical results and the discussion. The final section provides some concluding remarks, limitations and directions for future work.

2 Literature review

Since e-learning has been an important and ever more frequently used teaching technique in the past decades, there are also 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 the study process (Saba, 2012). But besides the many advantages of this type of study, there are also many disadvantages which can reduce the positive impact of modern ICT tools on students' performance. Moreover, in the e-learning process there are also

many specific factors involved that are not directly connected with ICT but importantly influence the students' performance, sometimes also in a negative way.

Sulčić and Lesjak (2009) claim that, although ICT represents a fundamental material condition for e-learning, it does not have a statistically significant influence on the effectiveness of e-learning. Similarly, Russell (2001) discovered no statistically significant differences between classical and online learning. They concluded that the classical contents (courses) should be adequately adapted for e-delivery. Different authors report varying attrition rates, e.g., from as high as 70%–80% ([Dagger and Wade, 2004](#); [Flood, 2002](#)) to 20%–50% ([Frankola, 2001](#); [Diaz, 2002](#)). These attrition rates can even be higher (between 10%–20%) than for traditional face-to-face education ([Carr, 2000](#)). When measuring students' performance also with other measures, [Novo-Corti et al. \(2013\)](#) report an increase in the performance of students (grades and qualifications) when using the mixed technology of e-learning in Moodle and face-to-face lectures.

According to [Ally \(2004\)](#), the teaching strategies as well as testing and assessment methods are much more important than the use of ICT in education. Students' non-participation in the learning process plays an important role in high dropout rates in online learning ([Dagger and Wade, 2004](#)). It is therefore very important to determine which approaches might increase student engagement ([Tyler-Smith, 2006](#)).

The review of the previous studies raises the dilemma of the validity of such comparisons since the statistics on retention and drop outs can be incomparable, unreliable and/or misleading ([Hall, 2001](#); [Haverila and Barkhi, 2009](#); [Saba, 2012](#); [Wang et al., 2003](#)). Researchers acknowledge that the reasons for attrition are many and complex and that there are no simple solutions ([Berge and Huang, 2004](#)).

The same is true for students' performance, measured as average grades and the average number of admissions to the exams. There are many factors that influence students' performance, such as ([Chien, 2012](#); [Haverila and Barkhi, 2009](#); [Kim and Kim, 2013](#); [Saba, 2012](#); [Upadhyaya and Mallik, 2013](#); [Yukselturk and Bulut, 2007](#)):

- learner characteristics (demographic factors, prior e-learning experience, ability and interest, motivation, self-regulation)
- supporting systems (organisational aspects – e.g., structure and institutional arrangements; people aspects – e.g., motivation, training, other stakeholders)
- e-learning system (quality of contents, tasks (instructor factors), technology – e.g., system reliability, user interface).

It can be deduced from the reviewed literature that there is a huge research gap concerning the contributions of socio-demographic factors of students involved in an e-learning system to their academic performance. Nevertheless, a few researchers have focused on selected socio-demographic aspects of e-learning, such as [Berge and Huang \(2004\)](#), [Yukselturk \(2005\)](#) and [Park and Choi \(2009\)](#). In general, however, individual factors (i.e., socio-demographic, e.g., age, gender, education etc.) seem to have little influence on student performance. Indeed, [Willging and Johnson \(2004\)](#) claimed that external factors such as family issues, lack of organisational support, and workload are the crucial factors affecting students' performance in an e-learning system (also see [Park, 2007](#)). Nevertheless, in our study we tried to fill above-mentioned research gap and highlight the importance of a selected socio-demographic background on (full-time) students' performance in the Moodle environment in public administration programs at the University of Ljubljana.

3 Moodle: e-learning platform at the faculty of administration (University of Ljubljana)

The open-source LMS Moodle is already widespread in all segments of education, from primary schools to universities. It is free, flexible, customisable and basically contains many standard features which make it popular. It is available in more than 100 languages. Today, more than 54,000 active sites are registered from 225 countries, with millions of users (Moodle.org, 2015). Kareal and Klema (2006) compared particular features of some open-source e-learning systems and found 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 as an extension of a classical learning process at a university and found that for students “the Moodle e-learning platform is easy to use and provides a good communication tool, discussion area, group space, workspace, and makes learning more interesting”.

The Faculty of Public Administration (FPA) is part of the University of Ljubljana, Slovenia, that develops administrative science through research and education as well as integration into Slovenian and international practice. The FPA offers two undergraduate study programs – the University Study Program in Public Sector Governance (US) and the Higher Education Professional Study Program in Administration (PS) – and one joint undergraduate University Study Program in Administrative Information Science (UI) together with the Faculty of Computer and Information Science. The undergraduate study program (first cycle) lasts three years (six semesters). Both undergraduate study programs of the FA, the First Cycle Professional Study Program in Administration and the First Cycle University Study Program in Public Sector Governance, meet the high quality standards defined by the European Association for Public Administration Accreditation (EAPAA). The FPA also offers the continuation of study in seven postgraduate programs. The study program is interdisciplinary, combining administrative, legal, economic as well as organisational and ICT courses. Consequently, the Faculty is organised in three chairs: the Chair of Economics and Public Sector Management, the Chair of the Administrative-Legal Area and the Chair of Organization and Informatics.

The FPA began with blended learning in 2005 with e-Campus, a payable platform for e-learning. By blended learning we mean the current use of the term, namely “combining internet and digital media with established classroom forms that require the physical co-presence of teacher and students” (Friesen, 2012). After three years of use, the learning platform was replaced with the open-source Moodle platform, mainly due to the user-friendly environment and cost benefits.

At the beginning, the traditional teaching techniques were combined with an e-classroom on the basis of the voluntary decision of lecturers themselves. In the 2010/11 academic year, introduction of the Moodle e-learning system as part of the teaching process became mandatory for all courses in the first year of undergraduate study, namely 20 to 30 % of the traditional face-to-face learning process was implemented in Moodle. In the next year, blended learning was implemented in the second year of study and in the 2012/13 academic year all undergraduate study courses had their own e-classroom in Moodle.

At the same time as implementing this combined method of learning, the rules (e-learning policies) on the quality of e-classrooms were determined. In accordance with these rules, any e-classroom has to include at least:

- an introductory section with basic information about the course and students' obligations
- two forums: a news forum aimed only to lecturers for posting messages to students and a discussion forum for communication between lecturers and students
- e-content – additional learning resources for independent online study (e.g., as links to web pages, pdf file, extracts of lectures in the classroom)
- self-evaluation activities for students (e.g., quizzes, short essay questions)
- assignments for students where lecturers' feedback about the correctness is mandatory (e.g., submission of a Word or Excel file, workshop).

At the end of each semester, a consultant reviews the e-classrooms for e-studies and assesses them regarding their compliance with these rules. The quality assurance of the pedagogical work in e-classrooms in accordance with the defined rules is thus regularly monitored and necessary improvements are made.

4 Empirical research

4.1 Methodology and data

In our study, we analysed the performance of undergraduate students in two study programs at the FPA (without the joint program) – the university (US) and the higher education professional study program (PS), in the period between the 2008/09 and 2013/14 academic years. We only included the compulsory courses for full-time students in our survey since the e-classroom for elective courses was completely mandatory. For each academic year, we surveyed all compulsory courses and checked what proportion of their realisation (lectures, practical exercises) was held in Moodle. Using preliminary analyses, we defined that a course can be understood as (also) executed in Moodle if at least 1/5 of its realisation is held in an e-classroom (i.e., a minimum three weeks in a semester of 15 weeks).

The purpose of the research was to find out if the introduction of the blended learning with support of the Moodle platform had increased the students' performance. We analysed and compared two indicators of students' performance, namely students' average grades and average required admissions to pass an exam in the years 'with Moodle' with the (previous) years without it. In the Slovenian higher education system, the grading scale ranges from 1 (minimum) to 10 (maximum) with six as a minimum passing grade. For our analysis, we used Student's t-test for two independent samples. Table 1 shows the number of students enrolled in both programs in each academic year between 2008/2009 and 2013/2014, where 'Moodle – NO' means years with only face-to-face classrooms and 'Moodle – YES' years with blended learning. Notice that in the last academic year all the courses are treated as courses with Moodle since it was mandatory for lecturers to have an e-classroom in Moodle. On the contrary, in the first two years (2008/09, 2009/10) there are no courses treated as courses with Moodle. In the interim period, we have both types of courses: face-to-face and blended classroom. It is therefore possible that the same students were selected for both the 'Moodle – NO' and 'Moodle – YES' samples since they attended both types of courses. Notice that we only

analysed obligatory courses so the students could not choose to be assigned to the ‘Moodle – NO’ and ‘Moodle – YES’ samples since they had to follow the lecturers’ decision.

Table 1 Students enrolled in each academic year – in study years of both programs

<i>Academic year</i>		<i>Moodle – NO</i>			<i>Moodle – YES</i>		
		<i>1st</i>	<i>2nd</i>	<i>3rd</i>	<i>1st</i>	<i>2nd</i>	<i>3rd</i>
2008/09	PS	213	0	0	0	0	0
	US	278	0	0	0	0	0
2009/10	PS	114	0	0	0	0	0
	US	208	210	0	0	0	0
2010/11	PS	157	0	96	133	0	0
	US	163	191	138	148	175	0
2011/12	PS	119	0	0	156	0	89
	US	108	140	147	109	0	0
2012/13	PS	0	0	0	133	0	65
	US	92	103	131	0	0	0
2013/14	PS	0	0	0	110	0	67
	US	0	0	0	93	80	82

Notes: PS – professional study program and US – university study program.

Source: Survey, 2014

As explained in the above literature review section, students’ performance is influenced by many factors. We decided to eliminate the impact of:

- 1 the fluctuation of lecturers
- 2 different generations of students.

Therefore, we only analysed courses where the same lecturer conducted a course without Moodle and later with it, both for at least two consequent years. This means we excluded all courses where the lecturer was changed. We also excluded courses where only one generation used Moodle or only one generation did not use it. Our original data table was therefore reduced to only 14 compulsory courses – four courses from the Chair of the Administrative-Legal Area, four from the Chair of Organisation and Informatics, and six courses from the Chair of Economics and Public Sector Management.

4.2 Empirical results

On the faculty level, the introduction of Moodle is related to a significantly increased student performance. The average grade rose from 6.98 to 7.11 (Table 2), making the difference of 0.13 points highly significant (p-value: 2.71E-7). The decrease in the average number of admissions needed for the exams is even stronger (Table 3) – it went down from 1.73 admissions (Moodle – NO) to 1.30 (Moodle – YES). The difference of –0.43 is even more significant (p-value: 7.26E-86).

Although the introduction of the Moodle platform at the faculty level showed a significant improvement, we assumed there might still be subgroups of students or

courses where the improvement is not significant. For a more detailed analysis, we collected additional data on courses and students (factors). We added data about the study program (US/PS), the year of study (1st, 2nd, 3rd) and the chair (organisational unit at the Faculty) to which a lecturer belongs. From the students' enrolment form we extracted data on the students' gender and the region of Slovenia where they were born. We only considered two 'regions' – 'Central Slovenia' where the faculty is located – and all other regions in Slovenia as one region ('other Slovenian regions'). In addition, we took the students' high school final grade into account – we formed four categories and classified our students according to those categories.

Table 2 Average grades for years with Moodle (Moodle – YES) and years without it (Moodle – NO) among different factors (study program, year of study, chair of lecturer; gender, region and high school final grade) with differences and corresponding p-values (Sig.)

	<i>Moodle</i>		<i>Difference</i>	<i>Sig.</i>	
	<i>NO</i>	<i>YES</i>			
<i>Program</i>					
University study program	6.99	7.12	0.13	3.18E-06	***
Professional study program	6.93	7.08	0.15	2.09E-03	
<i>Year of study</i>					
1st	7.09	7.20	0.11	6.80E-04	*
2nd	6.82	6.99	0.17	4.06E-05	***
3rd	6.89	6.94	0.05	2.40E-01	
<i>Chair</i>					
Economics and public sector management	6.79	7.06	0.28	4.88E-15	***
Administrative-legal area	7.24	7.37	0.13	1.10E-02	
Organisation and informatics	6.91	6.96	0.05	1.69E-01	
<i>Gender</i>					
Male	6.86	7.00	0.14	1.79E-03	
Female	7.01	7.15	0.13	6.21E-06	***
<i>Region</i>					
Central Slovenia	6.92	7.10	0.17	8.35E-07	***
Other Slovenian regions	7.03	7.13	0.10	3.17E-03	
<i>High school final grade</i>					
Sufficient (2)	6.89	7.01	0.12	1.46E-05	***
Good (3)	7.11	7.17	0.06	1.61E-01	
Very good (4)	7.41	7.45	0.04	3.43E-01	
Excellent (5)	7.61	7.61	0.00	5.01E-01	
<i>Together (at the faculty level)</i>	<i>6.98</i>	<i>7.11</i>	<i>0.13</i>	<i>2.71E-07</i>	<i>***</i>

Note: Difference is significant at the following levels: 0.1 (*), 0.05 (**), 0.01 (***)

Source: Survey, 2014

For each factor we calculated the average grade and the average number of admissions to the exams for all of their levels separately for the years with Moodle and the years without it. In Table 2 and Table 3, we report the averages and differences with corresponding p-values calculated with an independent samples t-test. We corrected the p-values with a Bonferroni correction and marked the significant ones with stars. The data in Table 2 indicate a highly significant increase in the average grade among the majority of categories.

The biggest increase in the average grade belongs to the courses in the Chair of Economics and Public Sector Management. The average grade rose from 6.79 to 7.06, with the difference of 0.28 points being highly significant (p-value: 4.88E-15). We also discovered highly significant increases for students from Central Slovenia (increase from 6.92 to 7.10, p-value: 8.35E-7), students from the University program (from 6.99 to 7.12, p-value: 3.18E-60), female students (from 7.01 to 7.15, p-value: 6.21E-6), students with high school grades 2 out of 5 (from 6.89 to 7.01, p-value: 1.46E-5) and students in the second year of study in both study programs (from 6.82 to 6.99, p-value: 4.06E-5). In the other subgroups, the increase in the average grade is not significant. On the other hand, it is interesting that the average grade went up in all subgroups with the only exception of students with an excellent high school background (grade 5 out of 5). We found at least one subgroup with a highly significant increase in the average grade for each factor (program, year, chair, gender, region, high school grades) which helps us identify where the implementation of Moodle seems to play an important role in achieving high students' average grades.

Table 3 shows a highly significant decrease in the average number of admissions to the exams among all categories. A slight exception is the factor 'high school final grade'.

Table 3 Average number of admission for years with Moodle (Moodle – YES) and years without it (Moodle – NO) among different factors (study program, year of study, chair of lecturer; gender, region and high school final grade) with differences and corresponding p-values (Sig.)

	<i>Moodle</i>		<i>Difference</i>	<i>Sig.</i>	
	<i>NO</i>	<i>YES</i>			
<i>Program</i>					
University study program	1.76	1.32	-0.44	3.40E-61	***
Professional study program	1.58	1.23	-0.35	9.16E-21	***
<i>Year of study</i>					
1st	1.72	1.20	-0.52	1.05E-75	***
2nd	1.76	1.43	-0.33	2.63E-15	***
3rd	1.66	1.44	-0.22	2.37E-04	***
<i>Chair</i>					
Economics and public sector management	1.76	1.27	-0.49	8.16E-58	***
Administrative-legal area	1.43	1.25	-0.17	7.17E-07	***
Organisation and informatics	2.02	1.42	-0.60	4.44E-28	***

Note: Difference is significant at the following levels: 0.1 (*), 0.05 (**), 0.01 (***)

Source: Survey, 2014

Table 3 Average number of admission for years with Moodle (Moodle – YES) and years without it (Moodle – NO) among different factors (study program, year of study, chair of lecturer; gender, region and high school final grade) with differences and corresponding p-values (Sig.) (continued)

	<i>Moodle</i>		<i>Difference</i>	<i>Sig.</i>	
	<i>NO</i>	<i>YES</i>			
<i>Gender</i>					
Male	1.78	1.32	-0.45	6.13E-23	***
Female	1.71	1.29	-0.43	1.90E-65	***
<i>Region</i>					
Central Slovenia	1.75	1.32	-0.44	2.81E-43	***
Other Slovenian regions	1.70	1.27	-0.43	3.21E-41	***
<i>High school final grade</i>					
Sufficient (2)	1.80	1.32	-0.47	1.17E-63	***
Good (3)	1.60	1.28	-0.32	4.20E-13	***
Very good (4)	1.40	1.21	-0.19	5.89E-04	*
Excellent (5)	1.43	1.13	-0.30	2.32E-03	
<i>Together (at the faculty level)</i>	<i>1.73</i>	<i>1.30</i>	<i>-0.43</i>	<i>7.62E-86</i>	<i>***</i>

Note: Difference is significant at the following levels: 0.1 (*), 0.05 (**), 0.01 (***)

Source: Survey, 2014

Students with an excellent (grade 5 out of 5) and very good (grade 4 out of 5) high school background saw a decreased average number of admissions. The drops from 1.43 to 1.13 (excellent students) and from 1.40 to 1.21 (very good students) are, however, too small to be significant. We can see that those students with a better high school background (grades) need fewer admissions than the students with lower high school grades. It is, however, encouraging that the Moodle environment helped students with a lower high school background reduce the average number of their admissions. Students with sufficiently high school grades (grade 2 out of 5) decreased the average number of admissions from 1.80 to 1.32. Although the decrease is significant for all factors, the data in Table 3 show a very significant decrease in the average number of admissions for the first year of study (from 1.72 to 1.20 with p-value: 1.05E-75) and female students (from 1.71 to 1.29 with p-value: 1.90E-75). We can also find highly significant differences in the University Program and courses from the Chair of Economics and Public Sector Management.

5 Conclusions

The results of our study indicate that the implementation of an e-learning system (Moodle) at the FPA, University of Ljubljana is related to a statistically significant increase in students' performance, measured as the average grade and the average number of admissions to the exams. We demonstrated that the courses from the Chair of Economics and Public Sector Management, female students and students with alower high school background benefitted more from the work in the Moodle environment than

the other groups of studied entities. Based on our empirical results, we can also conclude that almost all subgroups of courses and students reduced the average number of admissions to the exams and increased the average grades after the Moodle platform was introduced. Interestingly, the only subgroup of students which did not benefit much is the group of students with the highest grades from high school.

The main limitation of the research is the limited dataset (i.e., the reduction of the number of courses analysed due to the lecturers' fluctuation and different generations of students). Besides that, we did not take into account other individual factors (e.g., motivation) and external factors (e.g., contents quality, previous trainings in Moodle, instructor factors, technological characteristics of the Moodle platform). These factors should be the subject of our further research in the near future. We will focus on a single academic year for which we will conduct a survey about students' satisfaction with e-learning. We will ask them about their background in Moodle, preferences in learning, evaluation of e-classrooms (quality and usability of content, teachers' responsiveness, etc.), satisfaction with blended learning, etc. Afterwards, we will link the results of the questionnaire to the database with students' grades and demographic/socio-economic data. The survey will suggest possible relationships between students' satisfaction with e-learning and their effectiveness, and will show if there is variability among the analysed subgroups. Moreover, future research could also broaden the scope of the current study, which was restricted to the public administration program. Finally, additional studies should seek to analyse the data from different study programs in order to increase the validity of results for the entire University of Ljubljana. To conclude, the study results can still serve as important background material when deciding on the future development of e-learning at the Faculty of Administration as well as on the introduction of e-learning platforms at other faculties within the University of Ljubljana. The empirical results pointed out the main challenge: how to use the Moodle platform to increase the grades of students with the best high school backgrounds and therefore to increase the graduates' capabilities to solve challenges in public administration.

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