

From Classroom to Online Environment – The Comparison Analysis of the E-Learning Standards Before and during the COVID-19 Pandemic

K. Aleksić-Maslač, P. Vranešić and B. Sinković

Zagreb School of Economics and Management/Department of Management, Entrepreneurship and Digital Transformation, Zagreb, Croatia

kaleksic@zsem.hr
pvranesi@zsem.hr
bsinkovi@zsem.hr

Abstract - The Zagreb School of Economics and Management (ZSEM) has systematically used e-learning in teachings since its establishment in 2002, which has greatly helped in maintaining the quality of education even during the crisis that was caused by COVID-19. In order to systematically follow the quality of e-learning, ten standards were developed that are divided into four groups: static, dynamic, administrative and other. In this paper, the evaluation results of 134 courses will be analyzed of the undergraduate level of three academic years: 18/19, 19/20 and 20/21 in 4 groups of students - the Economics and Management groups in Croatian and English, the Business Mathematics and Economics group and Elective courses group. Regardless of the difference in the quality of the developed courses, all groups behave similarly and have an increase of 13-17% in regards to quality standards during the COVID-19 pandemic. The static and administrative standards have insignificant changes, while the dynamic and other standards have a significant rise. The analysis of individual standards shows that the usage of certain elements has highly increased. This example of good practice shows how, with good preparation and continuous improvement, it is possible to move from classical to online classes without major problems.

Keywords – *E-learning standards, COVID-19, LMS, student, quality*

I. INTRODUCTION

Based on the UNESCO data regarding COVID-19, the pandemic has hit over 1.5 billion students [1] which needed to transfer from the classical or hybrid way of learning towards online education. Although some institutions already had high standard criteria and used some sort of e-learning, this was still a concern for the majority of institutions over the world [2, 3, 4]. Thankfully, the transfer towards e-learning education was easier for institutions that were already open to the technologies that enabled distance learning. Student readiness to transfer to online lectures depends on so called mental condition and the variety of elements such as motivation, technical skills, equipment, etc. [5, 6], [2], and there are a number of different researches that shows how

students are aware of the positive sides that e-learning brings and in the majority of cases, the consensus is that it shows general satisfaction on transferring to e-learning and online classes during lockdown [7, 8, 9, 10].

Figure 1 shows the connection between distance learning, e-learning and online learning [11]. Although they are considered as different aspects, in majority of cases they are considered the same – just as it was perceived during the lockdown.

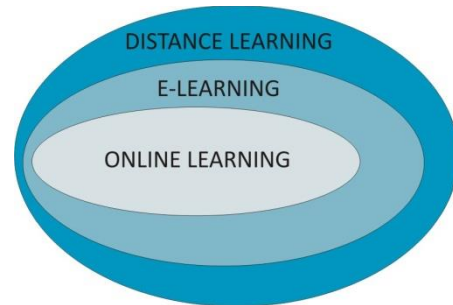


Figure 1. Connection between online learning, e-learning and distance learning

Learning Management System (LMS) plays a very important role as it is used for sharing different lecture materials, diversified assignments and ongoing communication between the student and the professor, but also between the student peers as well [12, 13, 14]. All LMS's have the same SCORM (Sharable Content Object Reference Model) standard, which is a model that accepts different interconnected technical specifications and instructions in designing educational content which is used for learning through the web. Every SCORM surrounding needs to indulge six basic requests: interoperability, accessibility, reusability, durability, maintainability and adaptability [15].

II. QUALITY MANAGEMENT OF E-LEARNING COURSES ON ZSEM

Zagreb School of Economics and Management has systematically used e-learning in education since its foundation of 2002 [16]. It is lecturers' obligation, which is in harmony with developed standards, to maintain and constantly develop e-learning courses on the LMS. Also, it is students' obligation to track all announcements and to do all of the needed assignments related to the enrolled course.

ZSEM has used WebCT as its first LMS, after which it transferred to Blackboard from 2011 to 2015. Since that time, the main LMS has been, and still is, Loomen, a Moodle version created and offered by CARNet (Croatian Academic and Research Network), which also offered a significant technical support throughout the years [17]. As lecturers and students on ZSEM are very familiar with new technologies, there are a lot of other elements that are used to enhance the online experience, such as intensive usage of gamification [18, 19], flip-classroom [20], different simulations and other technological possibilities. It's because of this readiness and well-established framework that made lockdown and transfer to distance learning easily shifted on ZSEM [21, 22].

Table 1 shows ten standards that were developed in 2006 on ZSEM and since that time, the team for evaluation of e-learning courses has been conducting yearly evaluations every academic year. Throughout the years, the standards have been changing and adapting, depending on the LMS usage and other factors [16]. The standards can be divided into four main groups:

- Static standards which are connected to main elements such as lectures that need to be updated regularly, syllabus and the overall design of the course on the LMS.
- Dynamical standards which are connected to the communication of lecturers and students through discussions, professor-student, student-student [23], different types of tests and announcements on the course.
- Administrative standards which are connected to maintaining the data base of students and lecturers.
- Other standards which are connected to additional elements such as synchronous and asynchronous distant learning, gamification, assignments, etc.

Faculty was trained to use the system with every transition, and all learning materials were centrally transferred to a new LMS. Joint workshops are held among the lecturers after the yearly evaluations overview in which experiences are shared and new ideas brainstormed. Online quizzes were already used live in computer lab during pre-COVID period, therefore question banks developed for years contained significant number of entries.

Students are trained to use the LMS from the very beginning of their program, making it mandatory tool for

fulfilling their assignments, following lectures, and communication with professors and colleagues.

Announcements regarding the lectures, assignments and exams are published on LMS, with email notifications automatically forwarded. Majority of the assignments are submitted using LMS, and some courses have also implemented the grading system.

TABLE I. STANDARDS FOR ONLINE COURSE QUALITY EVALUATION

STANDARD	DESCRIPTION
S1 – Syllabus (max – 10)	Syllabus needs to be regularly updated. – 5 Syllabus needs to be on the title page. – 5
S2-Lectures (max – 10)	There needs to be a folder Lecture with learning materials. – 5 Lectures need to be regularly updated. – 5
S3 – Design (max 10)	Pages are well organized, intuitive and easy to use. – 5 Pages are well designed and visually attractive. – 5
D1 – Calendar (max – 5)	Used for important events such as mid-terms, demonstrations, variety of assignments, etc. – 5
D2 – Notice (max – 5)	Regularly used announcements for news about the course. Not sending attachments but hyperlinks. - 5
D3 Discussion (max – 10)	Discussion is used for lecture materials and for communication on all levels – professor-student, student-student and student-professor. - 5 Developed discussions (at least 5 topics with min. 10 posts per topic) – 5
D4 – Online Tests (max 10)	Online quizzes used for homework, knowledge check, mid-term and exam periods. – 5 Developed question banks and online exams. – 5
A1 – Number of Students – 5	Regular update of student database. Tracking designer roles on the course. – 5
A2 Self-registration- 5	Enrollment key setup and enabled self-registration for students. – 5
O – Other (up to 10)	Synchronous elements used for distance learning (Zoom, Meet, Teams, etc.) - 5 Recorded lectures and adapted lectures for asynchronous distance learning (ADL). - 5 Gamification Assignments, etc.

III. RESEARCH RESULTS

The evaluation of e-learning courses has continuously been conducted since 2006 and at the end of each academic year, they are presented during the lecturers' council, and the feedback discussed is archived on a Moodle Loomen course "Notice board for lecturers". The importance of the evaluation of e-learning courses is shown through an initiative which is based on a strategic plan and states that no more than 10% of courses should be below the 50% average.

A. Analyzed sample

Table 2 shows the sample of N=398 analyzed courses before and during pandemic, while Figure 2 shows the distribution based on analyzed standards on N=134 courses in the academic year of 18/19 (before the pandemic), N=131 in the academic year of 19/20 (with second semester being during pandemic) and N=133 in the academic year of 21/22 (both semesters during pandemic).

TABLE II. ANALYZED SAMPLE OF N=398 COURSES

	18/19	19/20	20/21	Total
EM cro	43	43	43	129
EM eng	43	43	43	129
BME	24	23	24	71
Elective	24	22	23	69
	134	131	133	398

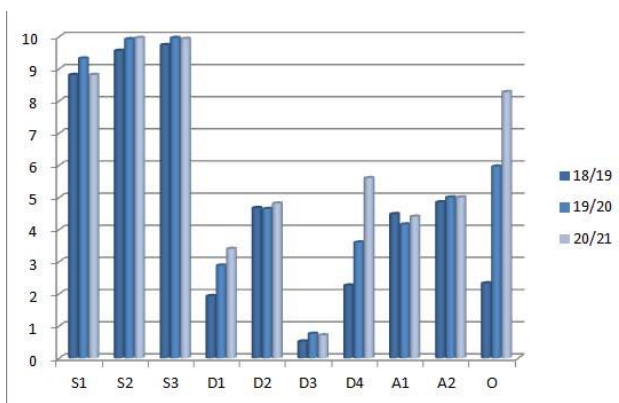


Figure 2. Distribution based on standards before and during pandemic

Static standards S1, S2 and S3 slightly oscillate, similar to administrative standards A1 and A2. Significant increase can be seen in D4 standard which is connected to online tests and O which is connected to a variety of elements regarding synchronous and asynchronous distance learning. It is interesting to notify that D3 standard, which is connected to discussions, did not have significant increase during the transition towards distance learning during the pandemic. Similar behavior of courses can be seen in the further analysis.

B. Analysis by program groups

Figure 3 shows an average of 4 different undergraduate study groups of academic year of 18/19 (before the pandemic), academic year of 19/20 (second semester was influenced by the pandemic) and academic year of 20/21 (both semesters influenced by the pandemic). The analysis represents these four groups:

- Economics and Management – Croatian group (EM cro)
- Economics and Management – English group (EM eng)
- Business Mathematics and Economics (BME)
- Elective courses (Elective)

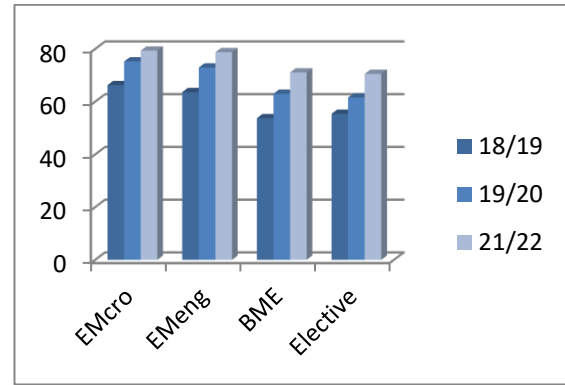


Figure 3. Quality average of e-learning courses by groups in different academic years

In the academic year of 18/19, before the COVID-19 pandemic, the best result is represented by the undergraduate study of Economics and Management Croatian group with a solid average of 66.63%. An evaluation has been made of all 43 regular courses, with only two courses that had an average less than 50%.

Similar situation can be recognized on the undergraduate study of Economics and Management in English, as there has also been 43 evaluated regular courses with two courses being below 50%, however, an overall average was 63.64%, which makes it lower than the Croatian group.

On the program of Business Mathematics and Economics group there has been 24 evaluated courses where most of the courses are of quantitative nature with mostly mathematics and programming, which are only held on the BME program. However, there are several shared courses that the BME students enroll with EM English group, but those results are a part of the evaluation of that program group. An assumption is that it also might be the reason why an average is lower in the last year evaluation before pandemic as it resulted with only 53.75%.

In the group of elective courses, there has been an evaluation of 24 courses, out of which there were even 5 courses that had an average less than 50% and an overall average is also significantly lower with the result of 55.4%.

Unlike regular courses, which are conducted regularly and already had been in use for years, which made it easy for further development and reaching a certain point of high quality, some of the elective courses have been only conducted once as it was their first year as part of the academic schedule and therefore need more time to reach better results.

Furthermore, some of the lecturers on elective courses are experts and specialists from business, which means that they have less academic experience in setting the syllabus, LMS course and other elements. This means that they need more time and support for higher quality development of the course.

During the pandemic, the second semester that was influenced in the academic year of 19/20, there has been a significant development and improvement of all groups,

especially in the ones that had a lower score before pandemic.

EM Croatian group, in accordance with the previous average, had a significant increase of 13.06%, making the final average of 79.36% and there was no course that was scored lower than 50%.

The EM English group had an overall average of 78.78%, which makes another significant increase of 15.17% in accordance with the previous average, and brought the score closer to the EM Croatian groups final score.

The most significant increase was BME group by 17.34%, making it a new overall average of 71.09%.

Elective courses also have a high increase of 15.17% and the result of 70.57%.

The continuous increase in evaluation results even after the lectures returned to the classrooms, points to the conclusion that once adopted and developed, e-learning became fully and equally embraced by lecturers and students.

Since e-learning was more in focus during the pandemic, it has become more important to improve its

quality and appearance and therefore usual topic during the faculty meetings, which also reflected in improved evaluation results.

C. Analysis by standard groups

Table 3 shows all unique standards in details over all three academic years, the year of 18/19, before pandemic, and two being during pandemic, 19/20 and 20/21 in all four analyzed program groups.

All groups show an increase, before and during the pandemic. In the category of dynamic and the rest of the standards by 6% on elective courses, by 18.3% on EM cro group, 20% BME and 20.46% on EM en group.

The largest share is referring to the D4 standard which is connected to online tests, which were intensively used in classes during the pandemic for mid-terms and exams.

The increase in O (other) category can be attributed to mandatory scheduling of online sessions during the pandemic, as well as publishing recorded lectures and adapted lectures for asynchronous distance learning.

TABLE III. STANDARDS FOR ONLINE COURSE QUALITY EVALUATION

	S1	S2	S3	S	D1	D2	D3	D4	D	A1	A2	A	O
E&M C 18/19	9.55	9.89	10	29.44	2.5	5	0.68	3.64	11.82	3.98	4.89	8.87	3.18
E&M C 19/20	9.65	9.88	10	29.53	3.26	5	1.05	5	14.31	3.84	5	8.84	7.56
E&M C 20/21	8.72	10.00	9.77	28.49	3.95	5	0.93	7.44	17.32	3.84	5	8.84	8.84
E&M E 18/19	8.64	9.89	10	28.53	2.27	4.77	0.23	2.84	10.11	4.55	4.89	9.44	2.84
E&M E 19/20	9.30	10.00	10	29.3	3.37	5	0.58	4.19	13.14	3.84	5	8.84	7.09
E&M E 20/21	8.49	10.00	10	28.49	4.07	5	0.58	6.63	16.25	4.53	5	9.53	8.72
BME 18/19	9.2	9.2	9.4	27.8	0.6	4.4	0.2	0.00	5.2	5	5	10	0
BME 19/20	10	10	10	30	1.88	4.58	0.42	1.88	8.76	4.79	5	9.79	1.88
BME 20/21	8.96	10	10	28.96	2.5	4.38	0.42	3.96	11.26	4.58	5	9.58	7.08
ELEC 18/19	7.27	8.64	9.09	25	1.59	4.09	1.14	0.91	7.73	4.77	4.55	9.32	2.27
ELEC 19/20	8.10	9.76	9.76	27.62	2.38	3.33	0.95	1.19	7.85	5	5	10	3.81
ELEC 20/21	9.38	9.79	10	29.17	2.08	4.58	0.83	2.08	9.57	5	5	10	7.71

Table 4 and Figure 4 show the differences between specific groups of standards prior and during the pandemic. In the static standards the changes are minimum, regardless if it and increase or decrease, and only significant increase that is worth mentioning is group of Elective courses which used the pandemic timeframe for further development of basic lecturing materials and content.

TABLE IV. STANDARD GROUPS BEFORE AND DURING PANDEMIC

	$\Delta S \%$	$\Delta D \%$	$\Delta A \%$	ΔO
EM cro	1.19	6.88	0.038	7.07
EM eng	0.05	7.68	0.11	7.3
BME	1.45	7.58	0.56	7.08
Elective	5.21	2.3	0.85	6.8

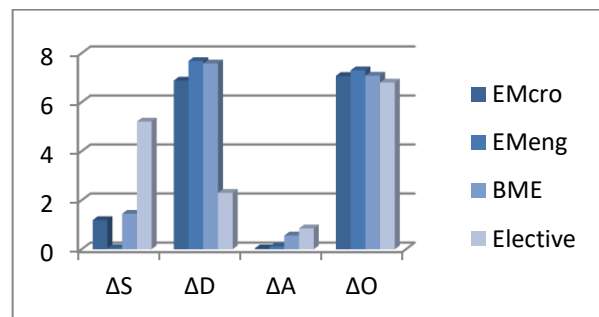


Figure 4. Differences between standard groups before and during pandemic

Dynamic standards in the first 3 groups have a significant increase, while the Elective group again shows deviation and lower rise than the static standards. A more significant contribution in all groups is D4 standard which relates to different types of online tests which are used for

home works, knowledge checks, mid-terms and exam periods. The expectations are that D3 standard is connected to discussions, but should also have a significant increase during the distance learning time, however, that didn't happen due to the new generation and their habits in quick chatting, which make their posts shorter than previous generations. The new generation uses different channels like Instagram, Messenger and Whatsapp. The changes in administrative standards are not significant at all, and in the category of other groups, they all act similar and have a certain increase. Usually this reflects on the synchronous distance learning and usage of the communication tools like Zoom, the one that is used on ZSEM and became a standard, but also the elements of asynchronous distance learning like recorded lectures.

IV. CONCLUSION

The goal of this paper is to quantify the changes in LMS usage and development in the transition from classroom to online environment during the pandemic. Since LMS has been in use at ZSEM from 2002, the accumulated experience of creating content and regular use of the system by students enabled smooth shift towards distance learning.

Ten standards in four groups already developed in 2006 to evaluate e-learning courses, have also been used to quantify the change in the volume and quality of the course content between academic years preceding and during the pandemic. All four groups of programs show an increase, before and during the pandemic on all of the four undergraduate study groups followed by research, with the exception of elective courses whose lecturers have less academic experience and needed more time to adopt.

Most significant increase was recorded in D4 (Online tests) standard, while the expected increase was not present in D3 (Discussion) standard due to change in communication habits among previous and current generations of students.

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