STUDENTS' PERCEPTION OF ONLINE VS. FACE TO FACE LEARNING OF STATISTICS. A SURVEY OF ROMANIAN STUDENTS

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This paper assesses students' opinions regarding online versus traditional teaching and learning of statistics (having experienced both), thus offering important insight for adjusting the challenging process of teaching statistics online. Results obtained from an online survey among students showed the effectiveness of the online method for teaching statistics and the positive attitude of students for this alternative method of education. There were no significant differences between face-to-face and online teaching of statistics related subjects in terms of perceived efficiency, engagement of students or attainment of learning objectives. The study reinforces the possibility of using E-learning for statistics related subjects, with even better efficiency than the traditional method of teaching reported for tasks involving statistical software. An assessment of advantages, disadvantages and development of the online classes is also provided. Thus, the paper draws on important good practices from online teaching of statistics that could also be used for traditional teaching.

INTRODUCTION

The coronavirus pandemic has generated great changes in the teaching-learning process of numerous higher education institutions. In many countries (including Romania), the face-to-face classes were switched to online education, an alternative method of teaching and learning that continued in some cases for more than a few months. Although E-learning has its benefits related to flexibility, control over the content or time spent learning, there are also issues that could hinder students' learning process – such as technical aspects, decreased motivation or the feeling of isolation (Suresh et al., 2018).

In this context, it is important and relevant to analyse students' opinions regarding the exclusively online education experience. The pandemic brought an abrupt switch from face-to-face to online teaching of statistics, which meant a rapid adjustment for students and teachers alike. However, designing successful online courses in statistics is a demanding and challenging topic (Everson and Garfield, 2008). In the pandemic context, most teachers didn't have enough time adapt the online teaching method and this could have an important impact to the outcome of the educational process.
That is why, in this paper, an investigation of Romanian undergraduate students' perceptions and attitudes towards online learning of statistics is proposed. In particular, the study addresses the effectiveness of teaching from a distance a Statistics course, within a comparative framework with the traditional face-to-face method of teaching statistics.

In order to reach the objectives, a survey was conducted by means of an online questionnaire distributed to a sample of Romanian undergraduate students. Data obtained from the survey was analysed using descriptive statistics and basic association tests. Main results showed the effectiveness of the online method for teaching statistics and a positive attitude from students towards the online Statistics course. No significant difference was established between the face-to-face and the online Statistics course in terms of perceived efficiency or attainment of learning objectives. An attempt to find the possible factors explaining the grade earned for the online Statistics course confirms that students with lower self-assessed IT skills obtained lower grades.

The results of the paper reinforce the possibility of using E-learning for teaching and learning statistics, with similar efficiency compared to the traditional face-to-face method. Moreover, the study highlights students' perceptions on online teaching and learning of statistics which could be used to further improve the entire online teaching experience.

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LITERATURE REVIEW

Online education, teaching and learning is not a new subject of study. Various research studies, models and evaluation criteria have focused on the quality of the online teaching or learning. As pointed out by Hodges et al. (2020), effective online learning outcomes are related to the attentive design and development of the online course. However, this design process is not available is cases of emergency shifts as was the one determined by the global pandemic. Theory identifies nine dimensions that have to be considered in the design of online courses: modality, pacing, student-instructor ratio, pedagogy, the role of the instructor online, the role of the student online, online communication, online assessments and feedback during online interactions (Means et al., 2014).

The impact of the pandemic on education, students and teachers alike, became a very researched topic following the outburst of the coronavirus pandemic in early 2020. Suddenly, higher education institutions switched to an emergency online mode, with students needing more assistance, teachers facing challenges and faculty administration having to reshape the operations in the campus (Marinoni et al., 2020).

A survey covering 424 universities from 109 countries showed that two-thirds of them replaced traditional face-to-face teaching with distance teaching and learning. This brought up challenges related to the technical aspects, but also to the competences and pedagogies required for distance learning. However, the experience of online learning opened new important opportunities and flexible learning scenarios (Marinoni et al., 2020).

Sun et al. (2020) conducted a large scale survey at a University in China, results evidencing that half of students believed that the teaching objectives were fully attained during online classes. Most challenging aspects for students were considered lack of self-discipline and concentration, technical problems and noisy environment.

In another article, Huang et al. (2020) highlighted some aspects that have an important role in improving distance learning: optimizing the internet and communication infrastructure, applying friendly tools and interactive electronic resources, but also usage of social networks in order to build online communities for reducing social isolation.

The perception of Polish medical students regarding online learning during the pandemic was investigated in a study by Baczek et al. (2021). The main advantages on online education identified by students were the accessibility to educational materials and the ability to stay at home. Main disadvantages quoted were lack of interaction with the patients and technical difficulties. However, there was no statistical significant difference between face-to-face and online learning in what concerns the learning method's ability to increase knowledge. Another study using mixed methods (Popa et al., 2020) focused on the teaching-learning behaviour in the online context generated by the COVID-19 pandemic. The main weakness identified for online education was the lack of real-time feedback given to students, but the efficiency of online teaching was acknowledged by both teachers and students.

In Romania, results from an online survey revealed that Romanian universities were not prepared for exclusively online learning. Most severe problems were related to technical issues and teachers not adapting their teaching style to the online environment (Coman et al., 2020).

Teaching statistics online is not a new topic and it has become a popular course option even before the pandemic. Teaching statistics online has evolved from issues related to course design, pedagogy and teacher instruction to more in depth topics. These refer to selecting the proper technology for conducting the online statistics class, develop the interaction between students and teacher, improving the online learning experience. (Mills, 2011).

DATA AND METHODS

In March 2020, all schools and universities in Romania switched abruptly to online education. For the Bucharest University of Economic studies, the online education continued for the entire 2020/2021 academic year. Undergraduate students from the International Business faculty under the Bucharest University of Economic Studies have taken a first course of Statistics (Introductory Statistics) in their first year of study (academic year 2018/2019) and a second course of Statistics (mainly Inferential Statistics, however labelled Econometrics in the curriculum) in the third year of study (academic year 2020/2021). Teaching statistics online was done using an audio and video platform (Zoom) and the University's dedicated online platform for chat and sharing course related

materials. The software used was Excel and the teacher shared the screen during seminars for Excel related tasks.

The first course of statistics was taken in a traditional face-to-face manner, while the second one was taken online, involving approximately the same teaching staff. This facilitates the comparison between the teaching-learning process of statistics in the two alternative ways.

In the period February – April 2021 an online questionnaire was distributed to students in the International Business Faculty. The entire corpus of students was of approximately 300 students, out of which 52 answered the online questionnaire. All students were informed about the aim of the study and gave their consent to participate voluntarily.

The questionnaire was developed following the methodology of Baczek et al. (2021) and Coman et al. (2020) and consisted of three main parts. The first part contained demographic details: gender, age, self-assessment of IT skills, previous experience with online courses and grade obtained for the Statistics course held online (50 answers for this optional question). In the second part, students were asked to choose advantages and disadvantages of online education, to give their opinion regarding the online learning platform or the preferred form of online interaction. The third part referred to the comparison between learning statistics in a face-to-face versus online environment, using the Likert scale (Likert, 1932). Students were asked to compare the two alternative ways of learning statistics in terms of their engagement, efficiency or attainment of learning objectives. An overall assessment of the online learning experience of statistics was also required.

For comparing the attitudes and opinions of face-to-face (labelled Statistics I) and online learning (Statistics II), the non-parametric Wilcoxon signed-rank test was used, since the variables involved were ordinal and the signed rank-test is often considered the non-parametric version of the paired t-test (Kerby, 2014). In order to analyse the association between the grade obtained and variables capturing the opinion of students regarding online learning of statistics, the F test and Spearmen coefficient of correlation were applied (Khanis, 2008). Data was analysed with Stata 16 statistical software.

RESULTS

The sample consists of 52 respondents, currently in the third year of the undergraduate program of International Business at the Bucharest University of Economic Studies. Consequently, the sample is very homogenous in terms of age, with an average of 21.4 years and a standard deviation of approximately 1.5 years. 81 percent of respondents are girls, following the gender distribution for this Faculty. Almost all students (94 percent) declared not having taken online courses before the pandemic.

Generally, students perceive themselves with good IT skills, less than 10% declaring to have low level of their information and technology knowledge (Table 1). The online platform used at University level is perceived as easy and very easy to use (83 percent of respondents), while the preferred interaction during the online learning sessions was with video from the teacher.

Asked to compare the amount of free time available with online learning compared to face-to-face learning, almost half of students answered they have less free time available when learning online, and slightly more than a quarter assessed they have the same amount of time available (Table 1).

The main advantages of online learning stated by respondents in the sample were the accessibility of online materials and the opportunity to stay at home, while the main disadvantages listed where the technical issues encountered (including Internet problems) and the social isolation from peers (Table 1).

There is no difference between face-to-face and online learning of statistics in terms of engagement of students (p-value 0.91) or meeting the learning objectives (p-value 0.28) – Table 3. The perceived efficiency of the two learning methods is similar (no statistical significant difference between the two – p-value 0.82), with 71% of students considering online learning of statistics effective and very effective (Table 2). Around a quarter of students consider they would have learned more or would have obtained a higher grade if Statistics II would have been conducted in a face-to-face regime (Table 2). Overall, slightly more than two thirds of respondents find the experience of learning Statistic II online enjoyable and very enjoyable with only 12% declaring they didn't enjoy it.

Table 1. Results of general questions regarding online learning

Level of IT Skills	Weight	Amount of free time	Weight
Low	9.6%	Less free time with online studying	46%
Medium	59.6%	The same amount of free time	27%
High	30.8%	More free time with online studying	27%
Generally the schedule was followed	Weight	Easiness in using the online platform	Weight
Completely disagree	4%	Very difficult to use	0%
Disagree	6%	Difficult to use	6%
Neither agree, nor disagree	21%	Neither easy, nor difficult to use	12%
Agree	40%	Easy to use	33%
Completely agree	29%	Very easy to use	50%
Preferred online interaction			
Video (teacher)	73%		
Audio	21%		
Chat	6%		
Advantages of online learning	Weight	Disadvantages of online learning	Weight
Flexible access to online materials	42%	Technical (connectivity) problems	35%
Opportunity of staying home	24%	Social isolation	28%
Time saved with transportation	19%	Reduced interaction with the teacher	23%
Nice/Comfortable environment	5%	Lack of self-discipline	7%
Opportunity to record a meeting	5%	Inadequate studying conditions (distractions)	7%
Opportunity to record a session	5%		

Source: author's calculation based on survey data

Table 2. Results of questions regarding comparison between learning Statistics I (face-to-face) and Statistics II (online)

Engagement in learning Statistics I	Weight	Engagement in learning Statistics II	Weight
Very inactive	2%	Very inactive	0%
Inactive	8%	Inactive	8%
Neither active, nor inactive	21%	Neither active, nor inactive	29%
Active	38%	Active	31%
Very active	31%	Very active	33%
Efficiency of learning Statistics I	Weight	Efficiency of learning Statistics II	Weight
Not at all efficient	4%	Not at all efficient	2%
Inefficient	13%	Inefficient	12%
Neither efficient, nor inefficient	15%	Neither efficient, nor inefficient	15%
Efficient	17%	Efficient	33%
Very efficient	50%	Very efficient	38%
Learning objectives were met for Statistics I	Weight	Learning objectives were met for Statistics II	Weight
Completely disagree	2%	Completely disagree	2%
Disagree	8%	Disagree	10%
Neither agree, nor disagree	10%	Neither agree, nor disagree	15%
Agree	27%	Agree	25%
Completely agree	54%	Completely agree	48%
Would have learned more is Statistics II would have been taught face-to-face	Weight	Would have a higher grade if Statistics II would have been taught face-to-face	Weight
Completely disagree	15%	Completely disagree	23%
Disagree	31%	Disagree	25%
Neither agree, nor disagree	17%	Neither agree, nor disagree	19%

Agree	15%	Agree	15%
Completely agree	21%	Completely agree	17%
Overall experience of learning online Statistics II			
Extremely unenjoyable	4%		
Very unenjoyable	8%		
Somewhat enjoyable	19%		
Very enjoyable	29%		
Extremely enjoyable	40%		

Source: author's calculation based on survey data

Table 3. Comparison of variables related to teaching and learning of Statistics I vs. Statistics II

Variables compared	Wilcoxon signed-rank test statistic	p-value
Engagement in learning Statistics I vs. Statistics II	0.151	0.9146
Efficiency of learning Statistics I vs. Statistics II	-0.240	0.8217
Objectives attained in Statistics I vs. Statistics II	1.080	0.2806

Source: author's calculation based on survey data

Next, we analyse the association between the grade obtained and several variables that capture the opinion of students regarding online learning of Statistics II (Table 4). As expected, there is a dependency (although not very strong) between the self-assessed level of IT skills and the grade obtained (average for students with low IT skills is 6.4, medium – 7.86, high – 8.6). The easiness in using the platform has no impact on the obtained grade and surprisingly neither is the level of engagement in the online learning session. However, the higher the perceived efficiency of the online method for teaching Statistics II, the higher the obtained grade (students considering the method not efficient averaged 5.75, compared to an average of 9 for those who regarded it as very efficient). What is more, the overall experience of learning Statistics II online is strongly associated with the obtained grade. Students who didn't enjoy the online method had an average of around 5, while the ones who find it very pleasant has an average of 8.95.

Table 4. Results of association tests between Grade obtained and perception on studying online

Variable	ANOVA (F Test)	Spearman correlation coefficient
Level of IT Skills	2.61*	N/A
Easiness in using the online platform	0.31	0.1380
Engagement in learning Statistics II online	1.94	0.3265**
Efficiency of learning Statistics II online	5.73***	0.5626***
Overall experience of learning online Statistics II	8.16***	0.4312***

*p-value < 0.1; **p-value <0.05; ***p-value <0.01
Source: author's calculation based on survey data

CONCLUSION

The COVID-19 pandemic has influenced teaching in most universities. Online learning has replaced the traditional face-to-face teaching starting with March 2020 in the Bucharest University of Economic Studies (BUES). In this study, we attempt to find the perception of students regarding online versus face-to-face learning of two subjects related to statistics using a survey among undergraduate students from the International Business Faculty under BUES.

Results from parametric and non-parametric association tests confirm that the main advantage of online learning is accessibility of online materials, while the main disadvantage lies in the technical problems. No significant difference could be established between face-to-face and online learning of

statistics in terms of engagement of students, perceived efficiency or meeting the learning objectives. Moreover, almost 70% of students in the sample have found the experience of learning statistics online enjoyable, some arguing that using the statistical software was easier in the online meetings than in traditional face-to-face classes. These findings support the usage of the online method for teaching statistics at least partly. It also reinforces similar results in the literature that outline the efficiency of the online courses (Baczek et al., 2021; Popa et al., 2020). The positive results obtained for the online Statistics course could also be due to the adjustment to E-learning from teachers and students, since Statistics II was taken after a three-months experience with the online environment. This could explain why the findings of this study partly contradict the results of Coman et al. (2020) who stated that the Romanian Universities were not ready for the online experience – their study being developed at the beginning of the pandemic. Analysing the possible factors for explaining the grade obtained at Statistics II, it is confirmed that students with lower self-assessed skills in IT have obtained lower grades, while those who enjoyed engaging in the online learning of statistics obtained higher grades. The engagement level during classes is not a good predictor for the grade.

Results should be treated with caution considering small sample size and lack of representativeness. However, the questionnaire could be replicated at a larger scale for validating the findings. Nevertheless, the usage of the statistical software was highly appreciated by students in the online teaching system and was assessed as better than in the traditional face-to-face environment. This could be pursued as a good practice in further Statistics courses.

Overall, students had an enjoyable experience in learning statistics online and this could be further pursued in our university. The advantages of online learning, like flexibility and accessibility of content were appreciated by students. However, teachers should focus more on using social features in order to ease the isolation feelings of students.

REFERENCES

Baczek, M., Zagańczyk-Bączek, M., Szpringer, M., Jaroszyński, A. & Wożakowska-Kapłon, B. (2021). Students' perception of online learning during the COVID-19 pandemic: a survey study of Polish medical students, *Medicine*, *100*(7).

Coman, C., Țîru, L.G., Meseșan-Schmitz, L., Stanciu, C. & Bularca, M.C. (2020). Online Teaching and Learning in Higher Education during the Coronavirus Pandemic: Students' Perspective. *Sustainability*, *12*(24), p.10367.

Everson, M.G. & Garfield, J. (2008). An innovative approach to teaching online statistics courses. *Technology innovations in statistics education*, *2*(1).

Hodges, C., Moore, S., Lockee, B., Trust, T. & Bond, A. (2020). The difference between emergency remote teaching and online learning. *Educause review*, *27*, pp.1-12.

Huang, R.H., Liu, D.J., Tlili, A., Yang, J.F. & Wang, H.H. (2020). *Handbook on facilitating flexible learning during educational disruption: The Chinese experience in maintaining undisrupted learning in COVID-19 Outbreak*. Beijing: Smart Learning Institute of Beijing Normal University.

Kerby, D.S. (2014). The simple difference formula: An approach to teaching nonparametric correlation. *Comprehensive Psychology*, 3, pp.11-IT.

Khamis, H. (2008). Measures of association: how to choose? *Journal of Diagnostic Medical Sonography*, *24*(3), pp.155-162.

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of psychology.*

Means, B., Bakia, M. & Murphy, R. (2014). *Learning online: What research tells us about whether, when and how*. Routledge.

Marinoni, G., Van't Land, H. & Jensen, T. (2020). *The impact of Covid-19 on higher education around the world*. IAU Global Survey Report.

Mills, J.D. and Raju, D. (2011). Teaching statistics online: A decade's review of the literature about what works. *Journal of Statistics Education, 19(2).*

Popa, D., Repanovici, A., Lupu, D., Norel, M. & Coman, C. (2020). Using Mixed Methods to Understand Teaching and Learning in COVID 19 Times. *Sustainability*, *12*(20), p.8726.

Sun, L., Tang, Y. & Zuo, W. (2020). Coronavirus pushes education online. *Nature Materials*, *19*(6), pp.687-687.

Suresh, M., Vishnu Priya, V. & Gayathri, R. (2018). Effect of e-learning on academic performance of undergraduate students. *Drug Invention Today*, *10*(9).