Network Technologies in E-Learning and Factors Influencing the Quality in the Covid-19 Period

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***Abstract**: Nowadays, network technologies of E-learning have been applied as support to adapt the teaching and learning in higher education. Therefore, E-learning is the utilize of network technologies to develop, adapt, address, and facilitate learning, anywhere, and anytime, which proved to be a very useful tool in the COVID-19 period. This research aims to determine whether there are statistically significant differences in students' responses to their demographic characteristics and their attitude towards the key determinants of the quality of e-learning at the time of the pandemic. The research was conducted by an online questionnaire among the students at the University of Belgrade, Serbia in the emergency. The questionnaire was fulfilled by 417 respondents. The paper examines the influence of gender, years of study, and the frequency of use of E-learning tools on the perception of quality. Obtained results show that students most recognize that E-learning is useful for studies during the pandemic, while they least recognize that the use of E-learning improves their efficiency during learning in the COVID-19 period. It can be concluded that quality assurance in education is a primary requirement for E-learning development by the modernization of teaching, the promotion of network technologies, and the establishment of a unique E-learning platform.*

***Keywords**: Network Technologies, E-learning, Quality Perception, Higher Education, COVID-19*

5 INTRODUCTION

As a blended, supplemental or only approach in higher education, E-learning has been becoming an emerging practice (Wong & Sixl-Daniell, 2017) among universities all around the world. Although widely popular and useful, this virtual learning carries with it certain risks, limitations, and issues such as just-in-time knowledge acquisition, interactivity, flexibility, and multimedia-integration (Zhang et al., 2004). However, in an emergency such as a pandemic, this way of learning has proven to be the only and most effective in all countries (Favale et al., 2020). Individual adaptation respecting their skills, knowledge, experience, and at the same time trying to, as lecturers, show a high level of empathy is not an easy task. E-learning is a process of "learning and teaching online through network technologies" (Hrastinski, 2008, p. 51) or, in more detail, it is "a web-based learning ecosystem for the dissemination of information, communication, and knowledge for education and training" (Cidral et al., 2018 p. 2). There are several papers deal with effects of gender, roles, age, race, and length of experience among students (Ruthotto et al., 2020). Even though these differences are the most common conducted research within E-learning contexts, limited studies are focusing on the demographic difference and other factors influencing students' perception of the quality of E-learning.

Hence, the paper aims to investigate if there are differences among University of Belgrade students perception of the quality of E-learning when it comes to gender and year of study. It is also explored whether the frequency of usage E-learning additionally influenced student perception of the quality of E-learning.

The paper will present the sections in the following order: after the introduction in the first section, and a review of the literature in the second, the third section is devoted to the explanation of the methodology. The results and discussion are presented in section four followed by the conclusion in section five.

6 THEORETICAL BACKGROUND AND HYPOTHESES

Gender difference has traditionally been associated with the attitudes that men and women showed toward network technology in E-learning (Padilla-Meléndez et al., 2013; Savara & Parahoo, 2018). Previous research confirms that there are differences in the attitudes, willingness to learn, aptitudes and behvaiour of students depend on gender. For example, through literature review, González-Gómez et al. (2012) came to the knowledge that male students are keener on using and learning about computers in comparison to female. Additionally, González-Gómez et al. (2012, p. 287) researched E-learning satisfaction based on gender differences and found that in their evaluation of E-learning, "female students showed a greater degree of satisfaction than male students". When it comes to quality perception, Jung (2012) showed that there were mean dissimilarities

between the female and male Asian learners in rating the quality dimensions in distance education. Yang (2008) found that male gives higher scores toward quality than female. On the other hand, Savara and Parahoo (2018) indicate that the same factors may be used to enhance the quality of learning experiences of both male and female students. Therefore, the following hypothesis is considered:

H1: Gender indicates a different perception of the Quality of E-learning.

When it comes to the connection between the perception of the quality of E-learning, ie. student satisfaction and the year of study, several articles deal with this issue. Cole et al. (2014) in their three-year study finds that there were no statistically significant variations in the degree of perception of quality based on gender or year of study. This implies that learners nevertheless employ the particular E-learning platform the university selected despite its quality. Similar relationships without mutual significance have been confirmed in other study (Cidral et al., 2018). On the other hand, a variation in the perception of quality has been noticed between the first and second year of study, where better perception was expressed by older students as they used network technologies for longer (Hernández Jorge et al., 2003). Therefore, the hypothesis is set:

H2: Higher maturity of students indicates a better perception of the Quality of E-learning.

In some review papers, it has been reported that the frequency of network technology use is related to the advantages of using the E-learning system (Petter et al., 2008). Students of Tripura University answered that about 50% of them are daily users of E-learning sites and about 20% of them use it on on weekly basis (Mishra et al., 2020). Similarly, the study showed the majority of undergraduate students in Nigerian universities employed E-learning technologies on a regular basis (Nnadozie, 2018). Kim-Soon et al. (2014) found that within the Malaysian University degree of quality of E-service supporting learning and the frequency of use from the E-service tools for coordination were rated as very good. Hence, the next hypotesis is developed:

H3: A higher frequency of using E-learning tools indicates a better perception of Quality of E-learning.

7 METHODOLOGY

To examine the impact of students' demographic characteristics on the Quality of E-learning during the pandemic period, a survey was conducted using an anonymous online questionnaire. The survey was carried out in March 2020 and involved 417 students from the University of Belgrade who answered two sets of questions from the questionnaire. The first group of questions in the questionnaire was related to the demographic characteristics of students, while the second part of the questionnaire referred to the items related to the quality of E-learning. For the

gradation of the obtained answers in the second part of the questionnaire, the Likert five-point scale was used. For the analysis of the obtained results SPSS 20.0 software was employed.

3.1. Descriptive data analysis

Based on the obtained values of descriptive data analysis, it can be concluded that in this research were gathered from a total of 417 answers. In research participated 26.3% male and 73.7% female. All respondents were separated in three groups from 18 to 26 years and above. It can be seen that most of the respondents are from the age of 22-25 years (51.4%) and the least respondents were from the group of 26 years and above (only 3.4%). In research were investigated the students from all years of study. Students from the first year participated 4.8%, from the second year 27%, from third-year 23.2%, followed by 47.8% form fourth year. In regards to E-learning knowledge before the pandemic period, the respondents indicated that most of them have good knowledge (45.7%). In terms of using the platform for E-learning before the state of emergency, 52.6% of respondents were used them, and on the other hand, 47.4% were not used E-learning platforms. In regards to the frequency using E-services during the pandemic period, 80.6% of the students indicated that they using E-services for learning 1-5 times per day and 12.2% are using E-services 6-10 times per day, whereas 1% of students use E-services more than 10 times per day, lastly, 6.2% of students did not use E-services during the state of emergency.

8 DISCUSSION OF RESULTS

The measurement of the reliability of the initial data for further analysis was performed using Cronbach's alpha coefficient. The obtained result presented in Table 2 indicates that the analyzed items within factor Quality of E-learning are reliable for further statistical analysis because the value of Cronbach's Alpha coefficient is more than the recommended 0.6 value (Nunnally 1978).

The results of the descriptive statistical analysis (Table 2) of the sample (N=417) show that students most agree that E-learning is useful for studies during the pandemic (M=4.11, SD=1.013), while they least agree that the use of E-learning improves their efficiency during COVID-19 (M=3.37, SD=1.173). Figure 1 presents the mean values of student's opinions related to each of the six items of Quality of E-learning. The mean values for communication, rapidity, productivity, effectiveness, and quality of learning are similarly and amount between 3.37 and 3.67, except for usefulness which amounts is over 4.11.

Exploratory Factor Analysis (EFA) was applied in order to determine the theoretically assumed structure of factors and to assess the reliability of measuring instruments related to the Quality of E-learning. The factors loadings range from 0.543 to 0.856 are presented in Table 1 and indicates high coexistence of variables within the considered factor. Principal component analysis (PCA) that represents the technique of factor analyze, was used to investigate the construct of the validity of the questionnaire (Fırat et al., 2017). The results of this analysis show that one component with 3.843 eigenvalues, explain 64.046% of the total variance.

Table 1. The Quality of E-learning

Items	Components	Mean	Std. Deviation	Cronbach Alpha
Q1_I think E-learning useful for my studies during the pandemic period	0.837	4.11	1.013	>0.7
Q2_Using E-learning would enable me to achieve learning tasks more quickly	0.846	3.58	1.163	
Q3_Using E-learning in my studying would increase my learning productivity during the pandemic period	0.856	3.57	1.247	
Q4_Using E-learning will improve my effectiveness during the pandemic period	0.837	3.37	1.173	
Q5_E-learning increases the quality of learning during the pandemic period	0.835	3.61	3.67	
Q6_Communication and feedback between the professor and student are effective	0.543	3.67	1.091	

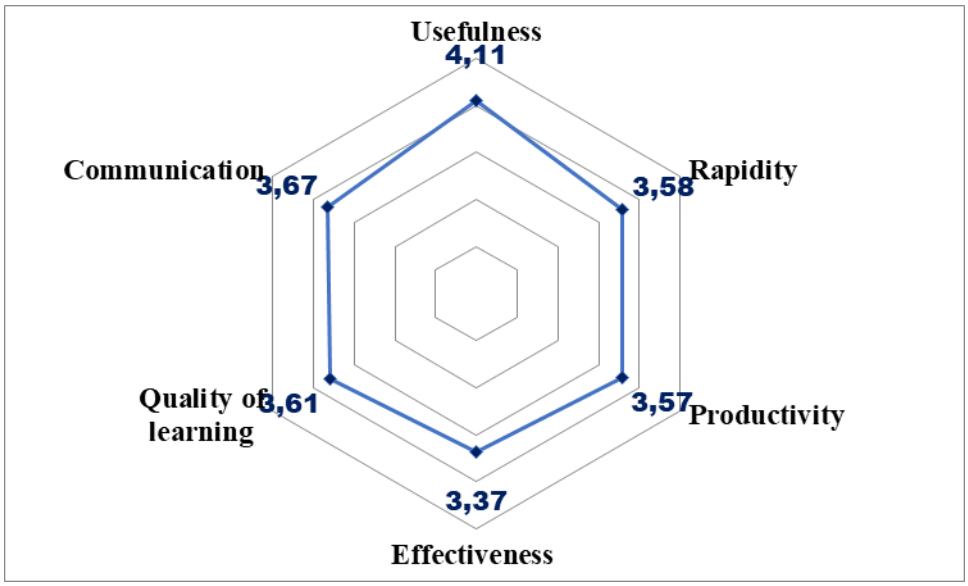

Figure 1.

The mean of items in Quality of E-learning

Pearson correlation was used for analyzing the relation between questionnaire items. The obtained results (shown in Table 2) were statistically significant at $p<0.01$ level.

Table 2. The analysis of Pearson correlation for the Quality of E-learning

Items	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6
Q_1	1					
Q_2	.722**	1				
Q_3	.638**	.687**	1			
Q_4	.604**	.614**	.686**	1		
Q_5	.609**	.579**	.680**	.695**	1	
Q_6	.383**	.392**	.325**	.346**	.387**	1

** Correlation is significant at the 0.01 level

To test hypotheses and to determine does statistical significance exist in responses from students' point of view on the Quality of E-learning, the analysis of variance with one factor (ANOVA) was used, and the set of statistical tests in SPSS 20 was employed.

The obtained results of the first analyzed hypothesis indicate that this H1 is rejected because the assumption about the homogeneity of variance is confirmed, as the value of the F test is small, F(3.65)=0.000, and the level of statistical significance is more than recommended value (p=0.987>0.05). That indicates that it does not exist gender differences in students' responses related to the Quality of E-learning. The mean value for males and females is the same and amount is 3.65. The same results (showed no significant difference) were obtained by the authors Mahvash and Maghsood (2014) when analyzing the quality of e-content from the students' viewpoints of Mashhad University of Medical Sciences. The authors Savara and Parahoo (2018) obtained the same results in research.

Within the second analyzed hypothesis, all students were analyzed according to the year of study they attended and were classified as students from the first to the fourth year of basic academic studies. Furthermore, the Quality of E-learning was analyzed with six variables: usefulness, rapidity, productivity, effectiveness, quality of learning, and communication. Analyzing all dependent variables the statistically significant differences have been found in usefulness question F(4.11)=5.252, p=0.000; rapidity question F(3.58)=5.262, p=0.000 and communication question F(3.67)= 3.313, p=0.011. The calculated arithmetic means indicate that first year students gave the least values of the usefulness of E-learning (3.20), while with the increase in the years of study, the level of quality perception is increasing as well, and for the fourth year students amount is 4.24. Identical results were obtained when it comes to speed to achieve E-learning tasks. The average grades of first year students are 2.90, while the average grade of fourth year students is 3.81. Further, a pronounced difference in student responses was observed in the satisfaction with mutual communication and feedback between professors and students that is achieved in E-learning. The lowest average grades had first year students 2.95, while the third year students gave higher rates (3.89). On other dependent variables, have not been determined the important differences in respondent opinions. Summarizing the results, it can be concluded that hypothesis H2 was confirmed, because there is an evident difference in the answers of students regarding the year of study students attend. The same conclusion is observed by Hernández Jorge et al. (2003).

The third analyzed hypothesis refers to the frequency of use of E-learning tools by students. A statistically significant difference was found in all variables related to the Quality of E-learning, and the obtained results indicate next: usefulness question F(4.11)=14.700, p=0.000; rapidity question F(3.58)=5.767, p=0.001; productivity question F(3.57)=5.223, p=0.002; effectiveness question F(3.37)=8.751, p=0.000; quality of learning question F(3.61)=8.110, p=0.000, and communication question F(3.67)=3.518, p=0.015. The opinion of students differed a lot when it comes to the frequency of using tools for E-learning. What is interesting is the fact that students who did not use any tools (6.2% of the total number of respondents) gave the lowest scores ranging from 2.50 to 2.92. The students who use more than 10 times per day some of the E-learning tools gave

higher value to the level of Quality of E-learning, so their average grades ranging from 3.84 to 4.25. Apparently, there are different students' viewpoints about Quality of E-learning during the pandemic period, and all these results indicate that hypothesis H3 is confirmed. These findings are corroborated by Dura and Mihăilescu (2014), and Martínez-Argüelles et al., 2013.

Conclusion

In higher education at Universities, the progress information and communication technologies open new perspectives for improving the teaching activities of students. The students' perceptions of service online quality in the pandemic period have become a very important aspect of differentiation in today's learning system. The University of Belgrade, which have a long learning tradition, is one of the higher education institutions in Serbia, which included the possibility in its development strategy the implementation of distance learning, which is in line with the adopted Strategy development of education in Serbia until 2020 (www.mpn.gov.rs).

In this research, the ANOVA test was performed for all considered hypotheses. The obtained results showed that not exist a significant difference between variables of Quality of E-learning concerning gender, indicating that the first tested hypothesis H1 was rejected. Considering the frequency of use of E-learning tools and year of study of students, they have diverse attitudes toward any of the dependent variables within the Quality of E-learning, which indicate that hypotheses H2 and H3 are accepted.

The model of tested hypotheses can be applied to many other research problems, but some constraints are inevitable. One of these constraints is respondents which were included in the research. Data of this research were collected in a short period to maintain the compatibility and coherence of data. The pandemic period that hit the education system all over the world forced professors to adapt their teaching activities to the online environment. Therefore, the results of this research are regarded as a snapshot of a certain time, and these results can vary as time passes. Another constraint of this research is the features of the sample. All participants in the survey were from Serbia. Nevertheless, the participants in the survey also can be included from other countries where students are faced with the same situation during the pandemic. Therefore, future research will be focused on performing another study on a larger scale level.

As a recommendation, the University should observe quality issues from a total quality perspective in higher education through a systematic approach of the network technologies and the establishment of a unique E-learning platform.

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