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Using t-Student and U-Mann-Whitney tests to identify differences in the study of the impact of the Covid 19 pandemic in online education in schools

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Abstract

The pandemic has represented an extraordinary time similar to natural calamities that radically transformed the way of society had to function. Freedom of movement but also physical proximity were restricted, proportional to the danger to the health of the population. In this context, solutions had to be established for the continuation of public and social activities. Therefore, certain fields of activity have been favored by the evolution of information technology, transferring to the online environment. The objective of the research is to identify the problems that emerged in the online teaching activity, during the Covid-19 Pandemic, which were the methods applied by the teaching staff for teaching and whether the students were able to participate and understand the notions taught in the online activity. The test t-Student and U-Mann-Whitney test were used to identify differences in the study of the impact of the Covid 19 pandemic in online education in schools in preuniversitary level.

1. Introduction

The goal of this research is to present how the schools activity proceeded during the Covid-19 pandemic, the effectiveness of learning but also what were the obstacles encountered by teachers and students.

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In this research, we start from the hypothesis that the Covid-19 pandemic had in the same time a positive and a negative impact both for teachers and for students in the context of the transfer of teaching activities to the virtual environment.

The main activities that affected data protection refer to the use of social networks or video conferencing systems, so pupils and students, even teachers, had to create accounts, sometimes without any filtering regarding the data transmitted. Some schools or faculties have created systems and accounts for all students, such as name, *surname@school*, without informing them or their parents, and there are serious doubts that a legitimate interest in the processing would have been documented, (see [1]).

The COVID-19 pandemic has had an unprecedented impact on all levels of education and learning around the world. At the beginning of April 2020, school closures in the 194 countries affected about 1.6 billion students at the pre-school, primary, secondary and high school levels, representing 90% of all students enrolled in the education system, (see [9], pp. 25-33).

For many students the school year ended at the beginning of March 2020, which means that important parts of their previously planned learning programs have not been completed. The constructive approach to education, according to which new knowledge depends on the understanding of older and simpler concepts, moving to higher grades without compensating for the loss of this knowledge would mean that many students will not be able to recover it. (see [3], p. 44).

Analyzing the education of the last decades we could highlight a series of changes and orientations that, at least partially, guide the steps forward made in science and technology. The adoption and effective incorporation of information and communication technology in school remains an uneven process since many teachers recognize its value and accept technology in school, but there are also teachers who do not embrace this idea of technology. (see [5], p. 20)

The individual level, high-speed computers and, by extension, the associated digital devices have changed the way we process information, i.e. the widespread use of computers has led to a better management of cognitive complexity. (see [4], p. 56).

The new technologies offer the chance of major transformations of the didactic processes, in an innovative and constructive sense. It is true that these transformations also involve the remodeling of teaching goals, teaching and assessment strategies (see [5], p. 59). We can talk about the emergence of a new environment of communication and social commitment, perceived as a norm, which gives a new dimension to communication and interpersonal relationships, shaping new experiences in terms of social responsibilities. The world

relies on the internet to connect to the latest information, to communicate with others through social networks. (see [9], p. 57).

In the educational space, teachers use electronic databases to conduct research and use the learning management system to teach online courses. From a social point of view, communication platforms such as: google chat, skype, e-mail and social networks (facebook, twitter, instagram) are used to connect with friends, colleagues and family members. (see [5], p. 47).

2. The t-Student and U-Mann-Whitney tests

In the following, we will shortly present the t-Student and U-Mann-Whitney tests. These tests will be used in this paper to identify differences in the study of the impact of the Covid 19 pandemic in online education in schools.

2.1. The t-Student test

In general, a t-test is any statistical hypothesis test under condition that the statistic test follows a Student's t-distribution, considered under the null hypothesis. Usually, it is applied in the situation when the statistic test can follow a normal distribution, again, under condition that the value of a scaling term in the statistic test was known, (see [10]). The name *student* is a pseudonym gave by W.S. Gosset, in 1908, when he published his results in the scientific journal Biometrika, (see [12]).

As initial conditions for this test, we must have:

-We have an interval measurement;

-Normal distributions in both samples;

-Equality of variances;

-N_1, N_2 of small size.

We remark that the above conditions are imposed by the fact that the authors have for this study small samples of data.

Otherwise, the condition of normality of the distributions in both samples is no longer mandatory, due to the Central Limit Theorem.

The following formula is used

$$t = \frac{\overline{m}_1 - \overline{m}_2}{\sqrt{\frac{\overline{\sigma}_1^2(N_1-1)+\overline{\sigma}_2^2(N_2-1)}{N_1+N_2-2}\left(\frac{1}{N_1}+\frac{1}{N_2}\right)}},$$

where $\overline{m}_1$ and $\overline{m}_2$ are the averages of the two chosed samples, $\overline{\sigma}_1^2$ and $\overline{\sigma}_2^2$ are the dispersions of the two chosed samples and N_1, N_2 represents the number of participants in each sample (their volumes).

We will compare the obtained value (by taking the absolute value), named t_{obt}, with the value t_{crit} at the chosen significance threshold. We say that t_{obt} is *significant* if it is less than or equal to t_{crit}.

By using the results obtained from t-Student test we can have the following situations:

-The null hypothesis (H_0), when there are no meaningful differences between the two samples, that means $\overline{m}_1 = \overline{m}_2$;

-The specific (alternative) two-way hypothesis (H_{s_1}), when there is a significant difference between the two samples, that means $\overline{m}_1 \neq \overline{m}_2$;

-The specific (alternative) unidirectional hypothesis (H_{s_2}), $\overline{m}_1 > \overline{m}_2$, (for example, boys feel the effects of the pandemic more strongly than girls).

Moreover, we can find how big is its effect. The effect size is calculated with the r_{pb} indicator, with formula

$$r_{pb} = \sqrt{\frac{t_{obt}^2}{t_{obt}^2 + gl}},$$

where t_{obt} is the value of t obtained from the calculation and gl is the *degrees of freedom*, $gl = N_1 + N_2 - 2$. For other details, the reader is referred to [11], pp. 60-66.

2.2. The U-Mann-Whitney test

The U-Mann-Whitney test (also known as *Mann–Whitney U test* or *Mann Whitney Wilcoxon test* or *Wilcoxon Rank Sum test*) is a nonparametric statistical test of the null hypothesis. That means that, for randomly selected values M_1 and M_2 from two samples, we have that the probability of M_1 being greater than M_2 is the same as the probability of M_2 being greater than M_1. The test U-Mann-Whitney test is used to test whether two samples are likely to derive from the same population (i.e., that the two populations have the same shape).

In the following, we will use the U-Mann-Whitney test to compare two samples when the value N in each sample is equal to or less than 20, the distributions are asymmetric, or the variances are not homogeneous. Scores are given directly in ranks. If we have an interval measurement, the raw scores are converted in ranks. For the explanation of the calculation algorithm for the ranks of the values for each sample, especially when the same value is found in both samples, the reader is referred to [13].

The used method

Step 1. We will assign ranks to all scores in the experiment (if the initial data are not presented directly in ranks, we consider the ordinal data). We have that the *rank 1* is given to the lowest score, *rank 2* to the next highest score and so on, no matters to which sample the respective score belongs to.

Step 2. We will compute the sum of ranks for each group (sample). The sum of the ranks from the sample of interest is denoted by $\sum R_1$ (or shortly R_1) respectively $\sum R_2$(or shortly R_2) and the number of scores (of values or of the participants) is denoted by N_1 respectively N_2.

Step 3. We compute two values for U: the value U_1 for group group number 1and U_2 for the group number 2. We obtain the following formulae:

$$U_1 = N_1 \cdot N_2 + \frac{N_1 (N_1 + 1)}{2} - R_1$$

and

$$U_2 = N_1 \cdot N_2 + \frac{N_2 (N_2 + 1)}{2} - R_2,$$

where U_i is the test statistic for the chosed sample of interest. We denote with s_U the *standard deviation*, given by the relation

$$s_U = \sqrt{\frac{N_1 N_2 (N_1 + N_2 + 1)}{12}}.$$

Step 4. We find the U-Mann-Whitney, denoted U_{obt}. The smallest value of U is chosen.

Step 5. We searching for the critical value for U.

Step 6. We compare U_{obt} with U_{crit} at the chosen significance threshold. If U_{obt} is less than or equal to U_{crit}, then the null hypothesis is accepted, therefore is accepted that there are no significant differences. If U_{obt} is greater than U_{crit}, then there are differences between the analyzed groups, (see [7], pp. 70-75) and [11], pp. 74-83).

The test is schematically presented in the Figure 1 from below:

3. A numerical application

The goal of this research is to highlight how the school activity went during the Covid-19 pandemic, what were the obstacles encountered by the teaching staff, but also by the students.

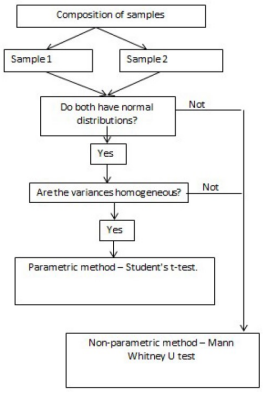

Figure 1: Algorithm of samples comparison.

The objective of the research is to identify the problems that have arisen in carrying out of the didactic activity in the online environment by analyzing gender differences with the help of the U-Mann-Whitney test and the t-Student test, during the Covid-19 Pandemic.

3.1. Working tools

In order to achieve this objective, an interview grid was created with 6 questions regarding the evaluation of online activities, the teaching methods used in online teaching and the difficulties they faced during this period. The questions have had five answer options, expressed on a scale of intensity from very little to very much and were the basis for formulating the hypotheses of this study.

Batch of participants

The interview grid was applied online between May 16-24, 2022 to a number of 70 students, both from the urban and rural areas, aged between 8 and 15 years. Convenience sampling was used to make up the sample. The research in the rural environment was carried out within the *Mihail Kogălniceanu Theoretical High School*, Constanţa county. The research in the urban environment

took place within the *Lazar Edeleanu* High School in the city of Năvodari, Constanţa county.

The students were informed about the application of the questionnaires and their confidentiality was assured by filling in a code composed of their initials and their birthday, therefore the subjects could not be identified. At the same time, they were assured that no one would have access to their individual answers. The parents expressed their agreement regarding the processing and presentation of the data obtained by fully completing the questionnaires. Their distribution by gender and by the place they belong to can be found in the Figure 2 from below.

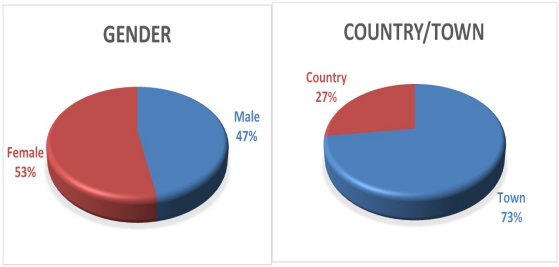

Figure 2: Distribution by gender and by the place they belong to

Working assumptions

1. *It is assumed that there are gender differences in the assessment of online activities during the pandemic period.*
2. *It is assumed that there are gender differences in the perception of didactic activities carried out online.*

Obtained results and discussions

First assumption. *It is assumed that there are gender differences in the assessment of online activities during the pandemic period.*

The null hypothesis: No significant differences are assumed in the assessment of online activities carried out during the pandemic according to gender.

The alternative hypothesis: Significant differences are assumed to exist in the assessment of online activities carried out during the pandemic according to gender.

To verify the first assumption, we calculate the main starting indices represented by average, median, variance and standard deviation for the two groups of participants.

Descriptives

	Gender		Statistic	Std. Error
How do you rate online learning activities?	Male	Mean	3.58	.222
		Median	4.00	
		Variance	1.627	
	Female	Mean	2.59	.221
		Median	2.00	
		Variance	1.803	

Figure 3: Descriptives

We note that that the verification of the hypothesis about the equality of dispersions is mandatory, if we want to use the t-Student test. If the dispersions, being unknown, we know that they are different, then we apply the Cochran-Cox criterion (see [6]) or the Levene criterion for calculating the equality of dispersions (see [2], p.157)

We remark that we obtained an average of 3.58 for the answers given by boys and 2.59 for the answers given by girls. To determine which algorithm to use, we will calculate the Kolmogorov-Smirnov coefficient for the normality of the data.

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Gender	Statistic	df	Sig.	Statistic	df	Sig.
How do you rate online learning activities?	Male	.236	33	.000	.872	33	.001
	Female	.185	37	.003	.887	37	.001

a = Lilliefors Significance Correction

Figure 4: Tests of Normality

As we can see, we obtained a significance threshold lower than 0.05, which leads us to use a non-parametric calculation method, namely the U-Mann-Whitney method.

As we can see from the rank table, we have the sum of the ranks for the sample of boys

$$R_1 = 1417$$

and the sum of the ranks for the sample of girls

$$R_2 = 1068.$$

Ranks

	Gender	N	Mean Rank	Sum of Ranks
How do you rate online learning activities?	Male	33	42.94	1417.00
	Female	37	28.86	1068.00
	Total	70		

Figure 5: Ranks

We will calculate the values of U for the sample of boys and for the sample of girls $N_1 = 33, N_2 = 37$. We obtain

$$U_1 = N_1 \cdot N_2 + \frac{N_1 (N_1 + 1)}{2} - R_1 = 365$$

and

$$U_2 = N_1 \cdot N_2 + \frac{N_2 (N_2 + 1)}{2} - R_2 = 856.$$

We calculate the value for U_{obt} as the lowest value obtained from the two samples and we compare this value with the value of U_{crit}. It results that $U_{obt} = 365$. For this purpose, we will transform the experimental value of the U-Mann-Whitney test into the standardized value called U_{crit}, to be able to make the comparison to that of a standardized normal distribution according to the significance threshold. Therefore, for the significance threshold of 95%, the standard value of comparison is 1.96, and for the significance threshold of 99% the standard value of comparison is 2.58.

$$U_{crit} = \frac{U_{obt} - \frac{N_1 N_2}{2}}{\sqrt{\frac{N_1 N_2 (N_1 + N_2 + 1)}{12}}} =$$

$$= \frac{365 - \frac{33 \cdot 37}{2}}{\sqrt{\frac{33 \cdot 37 (33 + 37 + 1)}{12}}} = \simeq -2.88$$

Since U_{crit} is higher than the standard value of 2.58 for a significance threshold of 99%, it results that the null hypothesis is rejected, therefore there are no significant differences between girls and boys in terms of evaluating online learning activities and it is accepted the alternative hypothesis that boys have rated online learning activities as more interesting than girls, as can be seen from the figure below.

We apply the Levene's test for equality of variances(see below) and we obtain

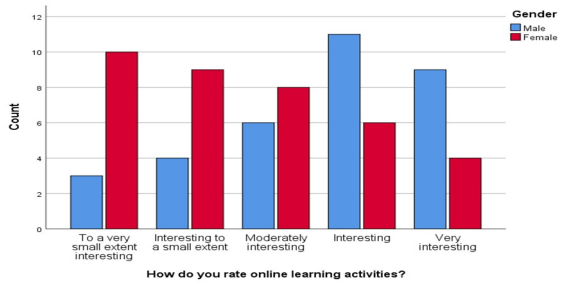

Figure 6: Online learning activities

		F	Sig.
How do you rate online learning activities?	Equal variances assumed	.322	.572

Figure 7: Levene's Test for equality of variances

In [8], the author consider that due to the technology-based education the student does not have to come to school to participate in teaching activities, but the school will come to the student, with all its offer regarding to contents and activities, through the computer and the Internet. The student accesses the online platform through an internet browser or a dedicated application, enters in a virtual classroom, participates in real time at the teaching activities, is able to interact by audio and visual means with his/her colleagues and the teacher solves learning tasks, reads bibliographic materials, gets involved in discussions or debates, all without leaving home. Online platforms are redefining the roles of teacher and student, by placing them in a virtual classroom. The student's activity is changed especially from the perspective of involvement and self-management, because the teacher is at a distance, and he/she is the one in charge of monitoring their own effort and motivation. The teacher and the student are aware that teaching and learning in the online environment obliges the latter to engage responsibly in their own training. The teacher's role is also changed:

-teacher becomes a manager of the students learning activity;

-teacher becomes a coordinator;

-teacher is a moderator;

-teacher is the tutor and platform administrator.

From here, it results the necessity to activate, at the level of the teaching staff, the following skils: the abilities for didactic design, the abilities for creation of work tasks, learning activities and interaction with students. Moreover, the management of skills in the school, the management of the virtual classroom and designing the levels of access and degrees of freedom for students and teachers, as users of the platform, also represent a necessity. For this purpose, a good computer training of teaching staff is necessary, a competence that requires initial training, but especially continuous specialized training (see [8]).

Second assumption. *It is assumed that there are gender differences in the perception of didactic activities carried out online.*

The null hypothesis: It is assumed that there are no significant differences in the perception of didactic activities carried out online according to gender.

The alternative hypothesis: It is assumed that there are significant differences in the perception of didactic activities carried out online according to gender.

The questions focused on the following aspects:

Q1. *The activities are flexible, I can learn when I want;*

Q2. *The activities are easy to do without traveling to school;*

Q3. *The activities are accessible (we have multiple possibilities to access the information if we need to learn: videos, worksheets, etc);*

Q4. *Enjoy using technology while learning;*

Q5. *Personalized tasks (each student can choose the right way to learn);*

Q6. *Improving the teacher-student relationship.*

To verify the second assumption, we calculate the main starting indices represented by average, median, variance and standard deviation for the two groups of participants.

From the analysis of the data in the table from Figure 8, we notice that we have obtained differences between the averages in the sample of girls compared to the answers obtained in the sample of boys. To check whether these averages are statistically significant, we check the normality of the data by using the Kolmogorov-Smirnov coefficient, see the table from Figure 9.

Therefore, we remark that we have a normal distribution on the two samples for the question *The activities are flexible, I can learn when I want*, which allow us to apply the parametric method of the t-Student test. For the other questions we apply the U-Mann-Whitney test as the non-parametric data processing method.

Descriptives

	Gender		Statistic	Std. Error
The activities are flexible, I can learn when I want	Male	Mean	2.79	.250
		Median	3.00	
		Variance	2.063	
	Female	Mean	3.08	.229
		Median	3.00	
		Variance	1.944	
The activities are easy to do without traveling to school	Male	Mean	3.27	.223
		Median	3.00	
		Variance	1.642	
	Female	Mean	2.57	.214
		Median	2.00	
		Variance	1.697	
The activities are accessible (we have more possibilities to access the information we need to learn: videos, worksheets)	Male	Mean	3.58	.222
		Median	4.00	
		Variance	1.627	
	Female	Mean	2.89	.232
		Median	3.00	
		Variance	1.988	
Enjoy using technology while learning	Male	Mean	3.42	.238
		Median	4.00	
		Variance	1.877	
	Female	Mean	2.62	.227
		Median	2.00	
		Variance	1.908	
Personalized tasks (each student can choose the right way to learn)	Male	Mean	2.55	.239
		Median	2.00	
		Variance	1.881	
	Female	Mean	3.51	.234
		Median	4.00	
		Variance	2.035	
Improving the teacher-student relationship	Male	Mean	2.33	.212
		Median	2.00	
		Variance	1.479	
	Female	Mean	2.43	.207
		Median	2.00	
		Variance	1.586	

Figure 8: Descriptives

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Gender	Statistic	Df	Sig.	Statistic	df	Sig.
The activities are flexible, I can learn when I want	Male	.160	33	.051	.876	33	.001
	Female	.146	37	.054	.891	37	.002
The activities are easy to do without traveling to school	Male	.200	33	.002	.902	33	.006
	Female	.182	37	.003	.890	37	.002
The activities are accessible (we have more possibilities to access the information we need to learn: videos, worksheets)	Male	.236	33	.000	.872	33	.001
	Female	.169	37	.009	.892	37	.002
Enjoy using technology while learning	Male	.208	33	.001	.878	33	.002
	Female	.214	37	.000	.875	37	.001
Personalized tasks (each student can choose the right way to learn)	Male	.200	33	.002	.872	33	.001
	Female	.228	37	.000	.850	37	.000
Improving the teacher-student relationship	Male	.214	33	.001	.876	33	.001
	Female	.229	37	.000	.878	37	.001

a = Lilliefors Significance Correction

Figure 9: Tests of Normality

To the question *The activities are flexible, I can learn when I want*, after performing the calculations we obtained the following result:

$$t = \frac{2,79 - 3,08}{\sqrt{\frac{2,06(33-1)+1,94(37-1)}{33+37-2}\left(\frac{1}{33}+\frac{1}{37}\right)}} = \\ = \frac{-0,29}{0,33},$$

therefore, by taking the absolute value, we have

$$t_{obt} = 0,87.$$

The obtained value is lower than the standard value of 1.96 for a confidence threshold of 95% which shows us that the difference between the two averages is not significant. Both girls and boys appreciate that the activities were flexible and allowed them to learn at their own pace, whenever they wanted, see Figure 10.

For the question *The activities are easy to do without traveling to school* we got the following sum of the ranks, see Figure 11,

Therefore, after calculations, for $N_1 = 33, N_2 = 37$, we have obtained $U_1 = 427$ and $U_2 = 653$.

We calculate the value for U_{obt} as the lowest value obtained from the two samples and we compare this value with the value of U_{crit}. It results that $U_{obt} = 427$. For this purpose we will transform the experimental value of the U-Mann-Whitney test into the standardized value called U_{crit} to be able to make the comparison with that of a standardized normal distribution

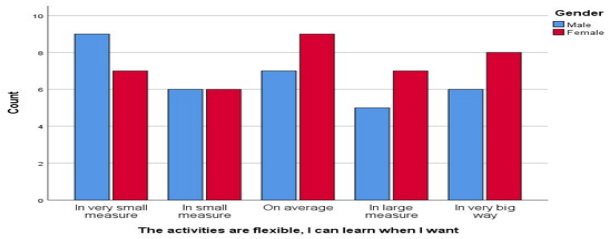

Figure 10: Q1

Ranks

	Gender	N	Mean Rank	Sum of Ranks
The activities are easy to do without traveling to school	Male	33	41.08	1355.50
	Female	37	30.53	1129.50
	Total	70		

Figure 11: Ranks

according to the significance threshold. Then, for a significance threshold of 95%, the standard value of comparison is 1.96 and for a degree of significance of 99%, the standard value of comparison is 2.58. With the above values, $U_{obt} = 427, N_1 = 33, N_2 = 37$, we obtain

$$U_{crit} = \frac{U_{obt} - \frac{N_1 N_2}{2}}{\sqrt{\frac{N_1 N_2 (N_1 + N_2 + 1)}{12}}} \simeq -215.$$

Since U_{crit} is greater than the standard value 1.96 for a confidence threshold of 95%, it results that the null hypothesis, according to which there are no significant differences between girls and boys in terms of the ease of doing school activities without going to the classroom class, is rejected. The alternative hypothesis, according to which boys appreciated more than girls the fact that they carried out school activities at home, is accepted, see Figure 12.

We will analyze the differences between the averages obtained on the question *The activities are accessible (we have multiple possibilities to access the information if we need to learn: videos, worksheets, etc)*. Being an asymmetric distribution of the results, we apply the U-Mann-Whitney test.

The sum of the ranks for the two samples is in the below table, see Figure 13.

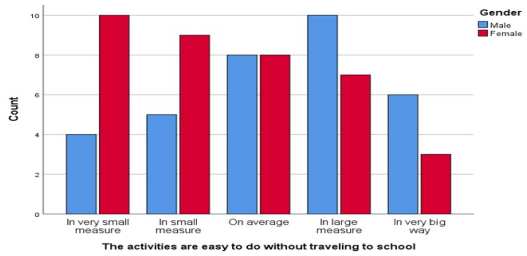

Figure 12: Q2

Ranks

	Gender	N	Mean Rank	Sum of Ranks
Improving the teacher-student relationship	Male	33	34.74	1146.50
	Female	37	36.18	1338.50
	Total	70		

Figure 13: Ranks

Therefore, we obtain the following results:

$$U_1 = N_1 \cdot N_2 + \frac{N_1\,(N_1+1)}{2} - R_1 =$$

$$= 33 \cdot 37 + \frac{33\,(33+1)}{2} - 1341 = 441$$

and

$$U_2 = N_1 \cdot N_2 + \frac{N_2\,(N_2+1)}{2} - R_2 =$$

$$= 33 \cdot 37 + \frac{37\,(37+1)}{2} - 1144 = 638.$$

We get the value $U_{obt} = 441$ to be the the lowest value obtained from the two samples and compare this value with the value U_{crit}. For this purpose we will transform the experimental value of the U-Mann-Whitney test into the standardized value called U_{crit}, to be able to make the comparison with the standardized normal distribution according to the significance threshold. Then, for a significance threshold of 95%, the standard value of comparison is 1.96, and for a degree of significance of 99%, the standard value of comparison

is 2.58. We have

$$U_{crit} = \frac{U_{obt} - \frac{N_1 N_2}{2}}{\sqrt{\frac{N_1 N_2 (N_1+N_2+1)}{12}}} =$$

$$= \frac{441 - \frac{33 \cdot 37}{2}}{\sqrt{\frac{33 \cdot 37 (33+37+1)}{12}}} \simeq -1,99.$$

Since U_{crit} is higher than the standard value 1.96 for a confidence threshold of 95%, it results that the null hypothesis, according to which there are no significant differences between girls and boys in terms of accessing multiple resources to carry out school activities, is rejected. The alternative hypothesis, according to which boys appreciated more than girls the fact that they were able to access more learning resources made available through the Internet, videos with information, files with solved applications and other helpful resources in carrying out the assigned tasks at school, is accepted.

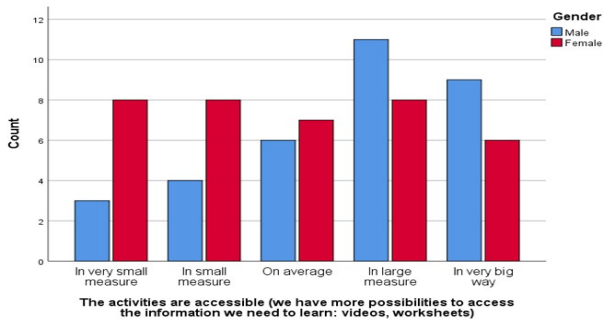

Figure 14: Q3

To see if this pandemic period in which daily school attendance was not possible due to the restrictions imposed led to the improvement of relations between teachers and students, it was also verified with the help of the U-Mann-Whitney test, due to the asymmetry of the responses received. Thus we obtained for the two samples the following sums of the ranks, see Figure 15.

To see if the experimental value is significant we calculate for each sample U_1 and U_2. We obtain

$$U_1 = N_1 \cdot N_2 + \frac{N_1 (N_1 + 1)}{2} - R_1 =$$

Ranks

	Gender	N	Mean Rank	Sum of Ranks
Improving the teacher-student relationship	Male	33	34.74	1146.50
	Female	37	36.18	1338.50
	Total	70		

Figure 15: Ranks

$$= 33 \cdot 37 + \frac{33\,(33+1)}{2} - 1146 = 636$$

and

$$U_2 = N_1 \cdot N_2 + \frac{N_2\,(N_2+1)}{2} - R_2 =$$

$$= 33 \cdot 37 + \frac{37\,(37+1)}{2} - 1338 = 444.$$

We remark that U_2 is the smaller value of the two considered in the experimental value of the test. We compare this value with the critical value of the test:

$$U_{crit} = \frac{U_{obt} - \frac{N_1 N_2}{2}}{\sqrt{\frac{N_1 N_2 (N_1+N_2+1)}{12}}} =$$

$$= \frac{444 - \frac{33 \cdot 37}{2}}{\sqrt{\frac{33 \cdot 37 (33+37+1)}{12}}} \simeq -1,95.$$

The calculated value of the test is less than the standard value of 1.96 for a confidence level of 95% which means that there are no significant differences between the two samples. Both girls and boys participating in the research stated that they did not feel an improvement in the relationship with the teacher. Even if the boys appreciated the online classes as easier, more pleasant, the relationship with the teaching staff suffered.

Similar results were obtained for questions Q4 and Q5.

Motivation is a complex part of human psychology and behavior that influences how individuals choose to invest their time, how much energy they exert on any given task, how they think and feel about that task, and how long they persist in that task.

Motivation is a process that begins with a physiological or psychological deficiency or need that activates a behavior or drive aimed at a goal or incentives. Students attribute various meanings and attitudes to school activities,

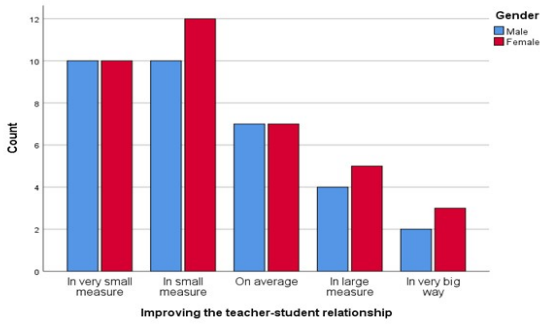

Figure 16: Q6

personal meanings and attitudes that arouse and direct their energies in different ways. These associated energizing and directing effects are referred to as motivation or sometimes motivation to learn.

For teachers, lack of motivation has long been one of the most frustrating obstacles to student learning. Teachers are the key factor in motivating students to engage in learning activities in their specific educational contexts. Performance is the direct result of learning and the main indicator that learning has taken place. A school's performance is measured primarily by how well students meet certain academic benchmarks and then by how well schools adhere to local, state, and national regulations. It is essential that teachers have measurable academic outcomes that monitor teaching and learning. The factors that determine school performance are both internal (individual) – biological factors, cognitive factors, motivational affective factors; as well as external (contextual) - socio-familial factors.

The emotional quotient leaves its imprint not only on school performance by making the student more emotionally balanced, but also has a direct influence on physical and mental health. The high level of stress that sets in as a result of the fact that the learner does not know how to manage time for studying planning or anxiety in front of the examination can cause health problems such as high blood pressure or inhibition of the effective functioning of the immune system. The negative impact of high stress levels is the implementation of a vulnerable state to anxiety and even depression.

Teaching staff have the role of transferring knowledge in the benefit of the intellectual development of students, to generate essential skills for the integration of each child in society, to encourage self-discipline to ensure that each

student can fully participate in and contribute to society, to introduce each child to ideas and opportunities that may not be available in their immediate vicinity; to identify each learner's personal needs, educational needs and career interests; to create a curriculum adapted to the requirements of each student. Given that society is marked by new rules and situations that require adaptive capacities, emotional intelligence becomes an increasingly valuable and relevant competence. Social interaction can occur when students work in pairs or groups (discussions, projects, presentations). They must be properly trained in the management of interpersonal relationships so that they learn to guard effectively together with the pair or group.

Rewards play an important role in motivating students and can include validation of ideas, attention, encouragement and support from teaching staff, awards for performance. It is preferable for teachers to pay attention to students when they request help, building a climate where students see mistakes as learning opportunities. Explaining mistakes and appreciating correct answers or small successes assures students that motivation is being harnessed.

Conclusions

The conclusions of this study support the fact that, under certain conditions, the presence on educational sites and platforms can create premises for collaboration for the purpose of learning and creating academic performance. An enabling environment is created where teachers and students can co-create active virtual learning environments. Although, students encounter certain difficulties in using online resources, they gradually fit into communities that integrate them and transfer significant knowledge. Therefore, different contexts are created through which they can practice their skills of presentation and writing of didactic content, to be able to share educational resources among classmates, creating original products, guiding group discussions, communicating and exchanging ideas among peers, etc.

Educational networks can also be evaluated in the form of the effects they have in terms of motivating students in order to achieve school performance. The benefits of social media for students are greatest when they are used more for learning and less for socializing. Recent research indicates that educational platforms support students in forming relational connections, enabling knowledge sharing, idea generation, creative production and student-to-student feedback.

We can observe the creation of a new dimension present in the life of the school through the integration of the Internet in teaching activities, in the

distribution of educational materials at a distance. Social networks can blur the boundaries between social learning spaces and leisure activities, which can contribute to a better teacher's knowledge of their own students. The teachers reported the positive influence of the educational platforms used in the teaching process by disseminating multimedia materials to the students. Social networks can stimulate the diversified participation of communication in school life by calling for partnerships, educational initiatives and projects, cultural activities, sports competitions and, in this way, can lead to school performance. In conclusion, thanks to the results obtained from the above questionnaires, it emerges that the research hypothesis is an affirmative one.

References

[1] Bogdan F., Ţoc S., *Policy note: Education during the pandemic. Answers to the endless crisis of the Romanian educational system*, Bucharest, 2020, https://snspa.ro/wp-content/uploads /2020/04/Policy-note-educatie_final.pdf

[2] Brysbaert M., *Basic Statistics for Psychologists*, Red Globe Press, 2011.

[3] Bush T., *Leadership and management in education. Current theories and practices*(translated in Romanian), Second Edition, Polirom Publishing House, Iaşi, 2021.

[4] Ceobanu C., *Learning in the virtual environment*(in Romanian), Polirom Publishing House, Iaşi, 2016.

[5] Ceobanu C., Cucoş C., Istrate O., Pânişoară I.O., *Digital education*(in Romanian), Polirom Publishing House, Iaşi, 2020.

[6] Cochran W.G. and Cox G.M., *Experimental designs* (2nd 4.), New York: John Wiley and Sons, 1957.

[7]Corder G.W., Foreman, D.I., *Nonparametric Statistics: A Step-by-Step Approach*(2nd edition), John Wiley&Sons, Inc., Hoboken, New Jersey, 2014.

[8] Glava C., *Online learning platforms. Premises, categories, essential characteristic*, in Ceobanu C., Cucoş C., Istrate, O., Pânişoară I.O., *Digital education*(in Romanian), Polirom Publishing House, Iaşi, 2020, pp.191-192.

[9] MacKenzie D. (2020), *Covid 19- The pandemic that was not supposed to exist and how to stop the next one*, Hachette Book Group, New York, 2020.

[10] Pfanzagl J., Sheynin O., *Studies in the history of probability*

and statistics. XLIV. A forerunner of the t-distribution, Biometrika. 83(4)(1996), 891–898.

[11] Sîntion F., Călin M.F., *Statistics in Human and Social Sciences*(2nd vol.), Ovidius University Press, 2015.

[12] Wendl M.C., *Pseudonymous fame*, Science, 351(6280)(2016), p. 1406.

[13] https://sphweb.bumc.bu.edu/otlt/mph-modules/bs/b704_nonparametric/bs704_nonparametric4.html

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