

How Did the Professors and the Students of the Faculty of Law Enforcement Manage Online Education Deriving from the Proceed of the Pandemic?

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After the one and a half year long online education on the Faculty of Law enforcement⁴, in the spring semester of 2020, we ran a unique survey among the population of both students and professors. We investigated how two different target groups coped with the challenges and the obstacles of the online education, by asking them similar questions that were comparable subsequently. We eagerly wanted to know, whether the professors from the diverse departments had the same hurdles as we had in the Department of Foreign Languages for Specific Purposes, and whether the students could hardly or easily manage the challenges of the online space. We examined the opinions and the experience of 216 students and 72 professors by a Google survey questionnaire, and we synthesized the drawbacks and the benefits of the online education through the glasses of the citizens of the Faculty of Law enforcement.

Keywords: Faculty of Law Enforcement, online education, obstacles, benefits, future perspectives

I. Introduction and literature

As it is the case with all researches, it was necessary to map the available Hungarian and international literature and surveys into the topic of online education during the pandemic. We focused on surveys and research findings which could be comparable to our designed research in a respect. The objectives, hypotheses, methods, instruments, and analysis strategies of the accessible material were subjects of our scrutiny, as well as underlying reasons behind the statistics and future recommendations. On revisiting these items, we encountered two Hungarian and two international surveys especially relevant to the one we designed. We believe that the comparative analysis of similarities and differences will help us put our own research into context and that it will also facilitate drawing conclusions.

Firstly, we examined the international researches, available into emergency online education in tertiary institutions. A survey carried out at a private university⁵ in Malaysia provided us with monumental aspects regarding its research methodology, target group and its findings. The study discusses students' attitudes and satisfaction with the quality of university services during

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⁴ Ürmösné Simon Gabriella, Borszéki Judit, Barnucz Nóra, Uricska Erna. A rendészeti szaknyelv szerepe a felsőoktatásban és az új nyelvi stratégia bevezetése. PORTA LINGUA 2021: 1 pp. 185-195, 11 p. (2021)

⁵ Asia e University, Kutching, Sarawak, Malajzia

remote teaching online.⁶ The implementation of unprecedented scenarios at the university induced diverse opinions which the researcher grouped in five different categories regarding students' satisfaction with e-curriculum, online assessment system, communication with the institution, technical solutions applied and course implementation. The online survey was carried out in 3 weeks in October-November 2020, comprising students of all educational levels and faculties of the private institution. Due to the relatively low number of valid incoming answers, the research utilized the tools of both quantitative and qualitative approach in its processes. It meant relying on statistical data analyses and conducting interviews equally. Its qualitative research rested upon filtering and clustering answers of repetitive phrases, identifying patterns, which is a method we also adopted in our own data processing. In its quantitative approach, respondents were able to provide answers on a 5-grade Likert scale, which helped design both the instrument and question types of the qualitative section in our own survey. Furthermore, we understood the significance of collecting sufficient samples. Therefore, it was also necessary to elaborate the technical details of receiving ample number of responses, in which we greatly relied on our colleagues' assistance in reaching the vast majority of student population at the Faculty of Law Enforcement, University of Public Service.

Reviewing the research findings of the neighbouring countries, we found numerous analogies between the Romanian and the Hungarian situations, that the shift to emergency online teaching was created in our countries' tertiary educational institutions. Contact teaching was terminated at the same time in both countries, in March 2020⁷. Moving lectures to virtual platforms did not necessarily come with methodological modernisation, and the problem of the execution of practice and hardware-heavy subjects remained⁸. The Romanian researchers extended the geographical scope of their survey to four traditional university towns around the country in April and May 2020. The survey consisted of 43 web-based questions with options expressed on the 5 grades of the Likert-scale. Regarding the summary of the 206 valid incoming responses, the survey provided a number of attention-calling attitudes. For instance, there is a considerable division in opinions when students had to express their satisfaction with various online platforms used during the seminars.⁹ According to the interpretation of the researchers, it must be due to the sudden shift to emergency online teaching from face-to-face contact lessons. This new protocol had no precedent in university curriculums prior to this. From the perspective of our own survey design, we concluded that the number of incoming responses was sufficient enough to support reliable statistical analysis. However, we must give potential verbal explanations with necessary precaution, and we only drew conclusions that are strengthened by the results of our multi-layered statistical analysis. For deeper analysis to disclose reasons of student and teacher attitudes, we provided the possibility of open-ended questions in our research, thus were able to give immediate verbalized explanations that went through are synthesis.

Having revisited international examples, we geared our attention towards Hungarian surveys into the ambiguities of online education at higher level institutions around the country. We were interested to know if there were research areas, hypotheses, results that are relevant only in the domestic environment. This interest guided us to review the survey carried out by colleagues at the University of Pannonia.¹⁰ At the very beginning of the pandemic, the researchers carried out their survey in 2020 March, discovering learning habits and using info-communication

⁶ Law Mei Yuan: Student's Attitude and Satisfaction towards Transformative Learning: A Research Study on Emergency Remote Learning in Tertiary Education. *Creative Education*, (2021). 494-528.

⁷ Maier, Veronica – Alexa, Lidia – Craciunescu, Razvan: Online Education During the COVID19 Pandemic: Perceptions and Expectations of Romanian Students. *ECEL*, (2020). 317-324.

⁸ Maier, et al (2020) i. m. 318.

⁹ Maier, et al (2020) i. m. 320.

¹⁰ Hargitai Dávid Máté - Sasné Grósz Annamária – Veres Zoltán: Hagyományos és online tanulási preferenciák a felsőoktatásban – A COVID-járvány kihívásai *Statistikai Szemle*, (2020). 839-857.

technology. Nearly 70% of the student population at the Faculty of Economics responded, provided ample valid samples. The research questions mapped the frequency of using traditional and digital learning materials, the various application of these according to gender¹¹, educational levels and forms. Based on well-justified statistical analyses, the consequences were drawn, which point to a more favourable digital material use at master level. With respect to our own planned research methodology, we found this statistical analysis exemplary, as well as the suggestions the researches made to future digital material inclusion in the learning process. The recommendations made, imply the necessary adjustment of the format of material to the gender: in lessons, dominated by female students, paper-based texts proved to be more suitable.¹² Regarding the targeted university population, we also adopted the idea that only one faculty's citizens should be involved in the research. As in faculties providing totally different training from our practice-oriented lessons such as shooting practice, fencing and horseback riding, the expected student satisfaction with the training and courses given in online environment will considerably differ from faculties that are more theoretically-oriented. Finally, we also had to observe the nationwide surveys that the Hungarian Student Governments Conference conducted into two different time periods in April and August 2020. The aim of the research was to collect the attitudes and experiences of students during remote online teaching. The survey reached the 279 faculties of 22 universities all around the country, providing 12000 valid answers. The focus of the research addressed the hypothesised contradiction between the overwhelming student dissatisfaction with online teaching and the wish to replace contact lessons with online lessons. According to the results, the vast majority of the responders formulated the idea that as much as 42% percent of contact lessons should be replaced with online lessons in the future.¹³ An important factor here is the high proportion (40%) of students doing parallel part-time work during their studies. The Hungarian Student Government, following the discussion of their research results, proposed a pack of suggestions to be discussed at national level with the Educational Office, in order to improve the general quality of services in tertiary-level higher education institutions. As regards the volume and scope of the research, we did not intend to compete with this research, rather, we took into consideration the various suggestions and recommendations, and their relevance to our planned target groups, students and professors at the Faculty of Law Enforcement.¹⁴ After the extensive literature process, we reckoned that the idea of addressing the same questions to both student and professors to map their attitudes, was unique in its kind.¹⁵ Thus, it would be a worthy of scientific interest substantiated with sufficient samples, adequate data process analysis and recommendations.

II. Method

As far as the sample of the research is concerned, it constituted of 216 students and 72 professors. As for the methodology, we applied a hybrid online survey (5-grade Likert scale), and open questions as well, with the help of a Google survey questionnaire. Regarding the phases of our research, first we indulged in domestic and international relevant researches,

¹¹ Ürmösné Simon G: Gender, szubkultúriák, genderpragmatika. In: Navracsics, Judit (szerk.) Transzdiszciplináris üdvözlések : Lengyel Zsolt számára. Budapest, Magyarország, Veszprém: Gondolat Kiadó (2014) 238 p. pp. 210-218., 9 p.

¹² Hargitai, et al (2020) i. m. 852.

¹³ Hallgatói Önkormányzatok Országos Konferenciája: Távoktatás jelentés (2020). 1-20.

¹⁴ Czenczer O. (2021). Pandémia – Paradigmaváltás a büntetés-végrehajtásban. Nemzetközi kitekintés és a magyarországi jó gyakorlatok bemutatása. *Bellügyi Szemle*, 69(5. ksz.), 12-36. <https://doi.org/10.38146/BSZ.SPEC.2021.5.1>

¹⁵ Czenczer Orsolya - Szenczi Attila: A reintegrációs őrizet jogi, technikai, biztonsági és társadalmi aspektusai, *Börtönügyi Szemle*, 2020/2. szám, 7.

regarding online learning attitudes and experiences and then we prepared the hybrid questionnaires, and forwarded them to university citizens. We had the assessment of surveys, data process of pie charts, categorization and the synthesis of the answers. We summarized the positive and the negative answers, drew the consequences, and proposed future perspectives and recommendations for best practices.

III. Results

Considering the synthesis of the *students' answers*, regarding the *advantageous factors* of the online education, in leading position we had the positive remarks on time saving, and the lack of the necessity for travelling. As a result, students spared much time and had better time management for preparation. They were more flexible, had more freedom and it was cost-efficient for them, because they did not need to commute, and much more time remained for their hobbies. It was also advantageous for them, that they could be in the vicinity of their family members and friends in their home environment. The students' responses also reflected the commonly recognised benefits of ICT tools.¹⁶ Their cognitive and ICT abilities enhanced, and they could learn on their own in a relaxed atmosphere. They had the capability of undertaking other jobs and as a consequence, they could earn extra money. It meant safety for them: they did not have to wear a mask at home, and they preserved their health. They managed to do more activities during the seminars and the lectures simultaneously, like popping in the nearby deli, or cooking, which were beneficial for them, yet for professors, it was frustrating. Considering the *drawbacks* of the online education they claimed, that they felt the lack of interaction, less students were active, and there was not a personal contact with professors. They were demotivated, and it was harder for them to persuade themselves to start studying, moreover, it was easier for them to be lazy. They lacked the community, the personal contacts, and felt isolated. They were deconcentrated, it was much harder for them to focus and concentrate: something always disrupted their attention, and there were a lot of disturbing factors in the vicinity at home. They had mood swings, because they had to sit a lot in front of the screen, and as a consequence, their health deteriorated: they had frequent headaches, and their eyesight worsened.¹⁷ They also claimed that their professors believed that they had more time for everything, and experienced that it was harder for the teacher to explain, demonstrate things and answer certain questions. Technological problems also arose i.e. the internet connection ceased, fluctuated, or it was insufficient, which caused a lot of annoyance and made it impossible to listen to the presenter. The practical seminars were difficult to be held, they had very limited time for tests or too tight deadlines, the online quality did not match up to offline quality either¹⁸. The learning time mingled in with spare time, students were overburdened, and it was harder for them to prepare for the seminars, and it was difficult for them to study, they became lazier, they gained superficial knowledge only, and their time management became worse. They were overburdened, the Internet provision halted for one or two days, they were preoccupied with everyday routines: for instance, the housework, the courier came during the seminar, or the cat distracted them. Technical issues arose as well i.e. power outage, few programs were running simultaneously, Wi-Fi problems technical problems occurred sooner with tutors, for example, the video froze in the middle of a lecture. They could hardly maintain the attention, felt apathy, and being closed in, moreover, they were really depressed by the lack

¹⁶ Borszédi Judit (2021): The Development of E-Learning Tools Used for Teaching English for Law Enforcement, INTERNAL SECURITY 13 : 1 p. 193. DOI: 10.5604/01.3001.0015.2908

¹⁷ Bacsó Bernadett: Családon belüli erőszak összefüggése a pszichoaktív szerfogyasztással, Magyar Drogfigyelő (2786-0906): 1 (1) pp 32-39 (2021)

¹⁸ Dominek Dalma Lilla – Barnucz Nóra – Uricska Erna – Christián László: Experiences of digital education from the perspective of students. Információs Társadalom 22(3), 2022 (forthcoming publication).

of social life. The other side of the coin was, when they felt flexibility, and they did not have to get up early. They had more spare time for working out, and being among their family members, and friends. For some students, the online education meant positivity, challenge, productivity, creativity, and calmness. They pursued sports, did garden work, renovated their apartment, and took up new hobbies. They had more inclination to deal with other things, they retained motivation, and became a lot more balanced and consistent. Some of them were happy to be able to spend more time within the family. As a contrast to this, they felt boredom, monotony, and claustrophobia: they were completely left on their own, due to lockdown and they missed the social life and their friends. Versatility was also experienced, there were some days when they were very creative and active, then on the other days, they were lazier and had less energy, as they claimed. Sometimes they were down, and as a contrary, on some days, they were more active than normally. The sedentary lifestyle also caused problems for them.

Our crucial question was: “what hindered your attention”, because we indeed wanted to know, why professors had to wait so long for the students’ reactions behind the monitors. Some students claimed, that nothing held them back, yet others claimed that they did not enjoy speaking in the first place. Some of them were uncertain, insecure, did not know the answer, could not phrase their reply, or they lacked knowledge. They were demotivated and did not feel as motivated as during a contact seminar, where they could have an eye contact with their tutor’s signalling, that they wanted to say something. The students did not know whether more than one person had intended to speak; the system jumbled, background noise in the vicinity was also disturbing, and it was chaotic for them, when there were 145 students on the lecture online. Some students claimed that other students had preceded them, or they were waiting for the others and could not see their mates’ reactions. They had also had a fear that while they were turning on their microphone, they might interrupt someone else. Summing up all the incoming answers, the total positive answers of the students were 284, whereas the total negative answers were 353.

Considering the *professors’ positive answers*, in leading position they also had the time saving remarks, and the lack of the necessity for travelling. They had better time management, and they could present the seminar from home. It meant flexibility, and comfort for them, and they could organize private life and their job better. It also meant an epidemic exempt environment for them, medical safety, and the possible treatment of the pandemic.¹⁹ Their ICT competences enhanced: they used the Moodle system more than usual, and learnt a great deal about the digital technologies, moreover, they obtained an ICT enriched user-experience. They improved their learning materials, familiarised with the IT solutions attached to the online seminars, and revised their presentations. As a contrast to this, they could motivate the students less, only few people could be activated, and it was more difficult to draw attention, or motivate them. Professors experienced the lack of feedback, interaction, and personal contact. The interest could not be controlled, and it could not be checked, whether the student was really present. Sedentary lifestyle, stiff limbs, sore neck, and the lack of blood circulation also caused problems for the professors. The commingling of private life and work and the deficiencies of the knowledge of techniques diminished the quantity of the teaching material. Isolation, the lack of personal connection, the loss of the personal contact and the lack of personal interaction could also be experienced. Convenience, sluggishness, enervation and the additional work also caused problems for the professors. The hiding of the students behind the monitors, the maintenance of the Internet, the change of the signal strength, occasionally the diminishing of the bandwidth,

¹⁹ Nyitrai, Endre: A koronavírus elleni küzdelem és a nemzeti adatvagyon újrahasznosítása a rendőrség vonatkozásában, In: Rixer, Ádám (szerk.) A járvány hosszútávú hatása a magyar közigazgatásra, Budapest, Magyarország: Károli Gáspár Református Egyetem Állam- és Jogtudományi Kar Lőrincz Lajos Közjogi Kutatóműhely (2021) 339-345.o.

the failure of the laptop, the lack of microphone, and camera were also frustrating. Microsoft Teams and Moodle problems also arose. Professors claimed that the passivity of the students, their lack of motivation, disturbing background, the lack of tolerance among the family members, frustrated them the most. On the contrary, the online education provided more freedom for some of the professors, and affected them definitely positively from all aspects, moreover, some of them achieved the level of a confident user and performer. The new challenges made a few of them enthusiastic. Other professors were disappointed, less motivated, and felt as if they were talking to an empty wall. It meant coercion and burden for them, because they were forced to new techniques. The separation of the working hours and the free time totally ceased, and they would rather have talked to “living people”, than initials on the monitor. They missed the clear eye contact and the mimics as well. It was impersonal and the lack of personal connections was embarrassing. Some professors could not perceive, whether the students had understood everything or not, and they could only feel the students’ body which was present. The professional disputes could not be carried out, and the students’ frequent pretexts were also embarrassing. Methodological restrictions i.e. how to manage the practical subjects, and the restrictions of the online space also caused problems. It was quite a lonely genre for some of the professors, as opposed to the real, offline educational situations. Simultaneous activities on the seminar i.e. eating, making phone calls (since the student’s microphone was switched on), cooking, renovations and popping in the nearby deli, were also frustrating for the professors. Background noise in the vicinity such as dog barking, baby blues, running water, the sound of the motor, phone ringing, the tapping of the woodpecker, the chirping of the parrot, the courier’s ringing the bell, were also bothering for not only the professors but the students as well. To sum up, the total positive answers and the advantages we can conclude 229 answers, whereas the total of the negative answers and the disadvantages claimed by the professors were 387.

A The evaluation of results of the questionnaire survey using mathematical statistics

For evaluating the collected data, using tools of mathematical statistics is necessary. Our objective is to compare students’ and professors’ answers, considering every single question. There are two populations: students and teachers, therefore the appropriate mathematical tool for analysing results is a two sample tests. Two such tests have been selected for this investigation, the two sample *t*-tests i.e. *Student*-test and the *Welch*-test. Both tests require a normally distributed sample, furthermore, for the two sample *t*-tests the equality of sample standard deviations is also a basic requisite, but not for *Welch*-test. Two independent tests have been chosen for confirming the statistical inference.

The level of significance is established as $\alpha = 0.05$ in every case. It means that the probability of the event that a true statement is rejected is $P = 0.05$. This is a commonly used significance level in statistics. Both tests were developed for comparing expected value (mean) of samples. The null hypothesis is that there is no significant difference between expected values, which means that if sample means are „visually” different, the reason is only the random nature of the data collecting procedure. The alternative hypothesis is that there is significant difference between expected values, in other words theoretical means are not equal. Our objective is to analyse the null- and the alternative hypothesis, considering every question in the questionnaire. The methodology is as follows:

Step 1.: Normality test by using Kolmogorov-test [1, 2]. This test can be applied for analysing a dataset, whether it follows a normal distribution, or not. The assumption, in other words the null hypothesis is that the sample is normally distributed, consequently the alternative hypothesis is that the sample is not normally distributed. Let $F(x)$ be the theoretical cumulative distribution function of the supposed normal distribution. Parameters, m and σ , the mean and

the standard deviation respectively, are estimated using the sample. The empirical distribution function $F_n(x)$ must be constructed, using data in the sample again. First of all, the supremum of the difference (D_n) of these functions, and then the test statistics (K) must be calculated, according to the following formulas:

$$D_n = \sup_x |F_n(x) - F(x)|; \quad K = \sqrt{n}D_n;$$

where n is the number of the observations. Considering the previously established confidence level, $\alpha = 0.05$, the critical value for this level is $K_\alpha = 1.36$, that is obtained from Kolmogorov distribution. If the test statistics is less than the critical value ($K < K_\alpha$) than the null hypothesis, which is that the sample follows normal distribution is accepted, otherwise it is rejected.

Confirming the inference of Kolmogorov test, another independent parametric test has been applied, the *Chi-squared* test [1, 2, 3]. The null hypothesis is that the sample follows normal distribution. The test statistics for this test is given by the following sum

$$\chi_n^2 = \sum_{k=1}^n \frac{(v_k - Np_k)^2}{Np_k};$$

that follows chi-squared distribution, where v_k is the number of observed answers on a Likert-scale, N is the total number of answers, p_k is the theoretical probability of the k th answer ($k = 1, 2, \dots, n$) assuming normal distribution, and n is the number of items on Likert-scale. The statistical inference is strongly affected by the degree of freedom of the distribution. The degree of freedom of the chi-squared distribution is " $n - 1 -$ the number of estimated parameters". In this case it is $n - 3$ because the mean and the standard deviation is estimated from the sample. The logic of the inference is exactly the same, if the test statistics is less than the critical value, the null hypothesis is accepted, and rejected otherwise.

Step 2.: Testing the equality of standard deviations σ_1 and σ_2 , because this is the necessary condition for the applicability of the two sample t -tests. For testing the equality, the F -test has been applied [2, 3]. The null hypothesis for the F -test is that standard deviation of samples is equal, the alternative hypothesis is that there is significant difference between standard deviations. According to the F -test, the ratio of sample variances, s_1^2 and s_2^2 , must be analysed, which follows F -distribution. The test statistics is the following fraction:

$$F = \frac{s_1^2}{s_2^2};$$

if the numerator is greater than or equals to the denominator, in other words the fraction must be greater than or equal to one. The idea is the same as before. If the test statistics F_α is less than the critical value, the null hypothesis is accepted, if greater, it must be rejected. In this case the critical value depends not only on the confidence level but on the degrees of freedom as well. The degree of freedom is always a function of the size of the samples. In our survey $n_1 = 216$ is the number of the students, and $n_2 = 72$, is the number of teachers. For F distribution degrees of freedom are $n_1 - 1 = 215$ and $n_2 - 1 = 71$ or in reverse order, depending on which sample standard deviation is greater. The first degree of freedom corresponds to the numerator in the test statistics.

Step 3.: Application of the two sample t -tests, for studying equality of expected values. If samples follow normal distribution (step 1.) and standard deviations are equal (step 2.) this test can be applied [1, 2, 3]. This test can also be applied under some more general circumstances,

if the ratio of variances is between 0.5 and 2, so if the variances are nearly equal. The null hypothesis is that expected values are equal $\mu_1 = \mu_2$. The test statistics, that is given by the following formula

$$t = \frac{\bar{x}_1 - \bar{x}_2}{s \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}; \text{ where } s = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}};$$

follows t -distribution. The degree of freedom of this distribution is $n_1 + n_2 - 2$. The critical value t_α is basically affected by the degree of freedom. If the absolute value of the test statistics is less than the critical value ($|t| < t_\alpha$), the null hypothesis is accepted, which means that mean values can be considered equal. However if the absolute value of the test statistics is greater than the critical value ($|t| > t_\alpha$), the null hypothesis is rejected, which means that there is significant difference between mean values.

Step 4.: Confirming the conclusion of the previous step, or if t -test can't be applied, due to the fact that standard deviations are not equal, another two sample tests have been used, i.e. the *Welch*-test [1, 2, 3]. This test is similar to the two sample t -tests but there are some differences. On the one hand, the equality of the standard deviations is not necessary. On the other hand, which is more important, the test statistics t and the degree of freedom n , that are given by the following formulas

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}; \quad n = \frac{(n_1 - 1)(n_2 - 1)}{(n_1 - 1)c^2 + (n_2 - 1)(1 - c^2)}; \quad \text{where } c^2 = \frac{\frac{s_2^2}{n_2}}{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

are partly very similar – considering the test statistics – but different at the same time – considering the degree of freedom –. The test statistics t also follows t -distribution, and the inference method is exactly the same. If the absolute value of the test statistics is less than the critical value ($|t| < t_\alpha$), the null hypothesis is accepted, which means that mean values can be considered equal. However if the absolute value of the test statistics is greater than the critical value ($|t| > t_\alpha$), the null hypothesis is rejected, which means that there is significant difference between mean values.

B Statistical inferences

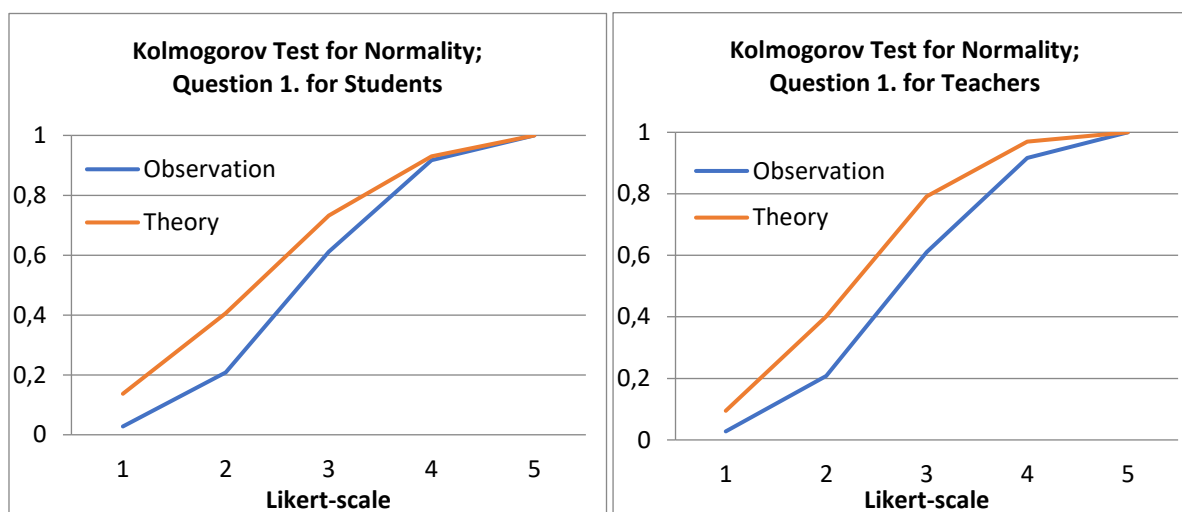
In this section the methodology, described in the previous section will be applied for every question in the questionnaire. Our objective is to compare the students' and teachers' opinion and evaluation, considering every single question separately.

C Findings

H1 1: There is no statistically significant difference in the opinion of students and professors judging whether they were able to acquire/pass on the same knowledge in the same depth as in the case of contact teaching.

The first task is always the goodness of fit test for normality. Reducing the number of similar figures in this study, the normality test is illustrated by graphs only for the first question. Kolmogorov-test for students and for teachers are depicted in Figure 1. respectively, by the graph of theoretical - orange curve - and empirical - blue curve - cumulative distribution function.

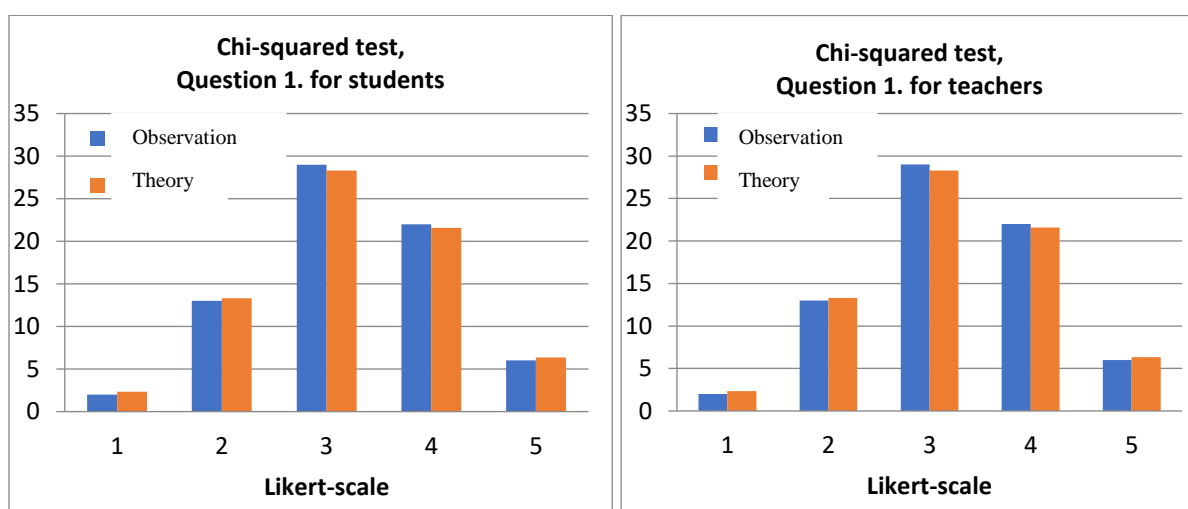
Figure 1: Kolmogorov normality test for question 1.



The inference for the goodness of fit test is based on the numerical data of the test. The Kolmogorov test statistics are 0.40 and 0.43, for students and for teachers respectively. The critical value for both samples is 1.36, therefore the conclusion is, that the null hypothesis must be accepted, the distribution of answers on a Likert-scale follows normal distribution. Similar results can be obtained for every other question.

Confirming this result, the Chi-squared test has also been applied. In figure 2. the number of observed answers - blue bar diagram -, and, assuming normal distribution, the theoretical prediction - orange bar diagram -, can be visualized. These graphs might be more convincing, the number of answers follow normal distribution, but the final inference is determined by numerical data again. Considering the degree of freedom, which is 2 and the level of confidence ($\alpha = 0.05$) the critical value is 5.99 for both samples. The test statistics are 4.11 and 0.09 for students' and for teachers' answers respectively. As a result, we came to the same conclusion, that both samples are normally distributed, therefore tests, discussed in the previous section can be employed. Considering every other question, the procedure for the proof of that the answers are normally distributed, is the same.

Figure 2: Chi-squared normality test for question 1. Observed and predicted number of answers



The following task is the application of *F*-test, *t*-test and *Welch*-test as it was discussed in the previous section. Results are summarized in one chart in every case.

Table 1: The results of the hypothesis testing procedure for question 1.

Hypothesis testing for Question 1. In your view, were you able to acquire/pass on the same knowledge in the same depth as in the case of contact teaching?					
<i>F</i> -test		<i>t</i> -test		<i>Welch</i> -test	
Test statistics	1.53	Test statistics	0.27	Test statistics	0.31
Critical value	1.39	Critical value	1.96	Critical value	1.98
Conclusion	$\sigma_1 \neq \sigma_2$	Conclusion	$\mu_1 = \mu_2$	Conclusion	$\mu_1 = \mu_2$

Considering *F*-test, the null hypothesis must be rejected, the standard deviations are not equal, but since $s_1^2 = 1.36$; $s_2^2 = 0.88$, the ratio of variances is between 0.5 and 2, so the weaker form of *t*-test can be applied, which says, that expected values are equal. This result is supported by the *Welch*-test, which says the same. The empirical mean values are $m_1 = 3.27$ and $m_2 = 3.23$ respectively. As a consequence, we can conclude, that there is no significant difference between the students' and the teachers' opinion, considering question 1, therefore $\mu_1 = \mu_2$. The students' and the teachers' evaluation are the same. The reason for the difference between the sample means is only the random property of answers.

H 2: There is no statistically significant difference in the opinion of students in judging whether they had their opportunity to continue studying/teaching offline, would they have preferred to do so?

Table 2: The results of the hypothesis testing procedure for question 2.

Hypothesis testing for Question 2. If you had the opportunity to continue studying/teaching online, would you prefer to do so?					
<i>F</i> -test		<i>t</i> -test		<i>Welch</i> -test	
Test statistics	1.07	Test statistics	-0.67	Test statistics	-0.66
Critical value	1.35	Critical value	1.96	Critical value	1.98
Conclusion	$\sigma_1 = \sigma_2$	Conclusion	$\mu_1 = \mu_2$	Conclusion	$\mu_1 = \mu_2$

Considering *F*-test, the null hypothesis must be accepted, the standard deviations are equal, so the *t*-test can be applied, which says, that expected values are equal. This result is supported by the *Welch*-test, which says the same. The empirical/sample mean values are $m_1 = 3.62$ and $m_2 = 3.75$ respectively. We can conclude, that there is no significant difference between the students' and the teachers' opinion, considering question 2, therefore $\mu_1 = \mu_2$. The students' and the teachers' evaluation are the same. The reason for the difference between sample means is only the random property of answers.

H 3: There is no statistically significant difference in the opinion of students and professors judging whether they received/provided all possible help within the framework of online education.

Table 3: The results of the hypothesis testing procedure for question 3.

Hypothesis testing for Question 3. Have you received/provided all possible help within the framework of online education?					
<i>F</i> -test		<i>t</i> -test		<i>Welch</i> -test	
Test statistics	1.34	Test statistics	1.67	Test statistics	1.56
Critical value	1.35	Critical value	1.96	Critical value	1.98
Conclusion	$\sigma_1 = \sigma_2$	Conclusion	$\mu_1 = \mu_2$	Conclusion	$\mu_1 = \mu_2$

Considering F -test, the null hypothesis must be accepted, the standard deviations are equal. So the t -test can be applied, which says, that expected values are equal. This result is supported by the $Welch$ -test, which says the same. The empirical/sample mean values are $m_1 = 4.47$ and $m_2 = 4.31$ respectively. We can conclude, that there is no significant difference between the students' and the teachers' opinion, considering question 3, therefore $\mu_1 = \mu_2$. The students' and the teachers' evaluation are the same. The reason for difference between sample means is only the random property of answers.

H 4 Students were more motivated about online education than professors

Table 4: The results of the hypothesis testing procedure for question 4.

Hypothesis testing for Question 4. Have you/your students been motivated enough within the framework of the online education?					
F -test		t -test		$Welch$ -test	
Test statistics	1.43	Test statistics	2.03	Test statistics	2.22
Critical value	1.39	Critical value	1.96	Critical value	1.98
Conclusion	$\sigma_1 \neq \sigma_2$	Conclusion	$\mu_1 \neq \mu_2$	Conclusion	$\mu_1 \neq \mu_2$

Considering F -test, the null hypothesis must be rejected, the standard deviations are not equal, but since $s_1^2 = 1.27; s_2^2 = 0.88$, the ratio of variances is between 0.5 and 2, so the weaker form of t -test can be applied, which says, that expected values are not equal. This result is supported by the $Welch$ -test, which says the same. The empirical mean values are $m_1 = 3.41$ and $m_2 = 3.11$ respectively. We can conclude, that there is significant difference between the students' and the teachers' opinion, considering question 4. Taking into account sample mean values, the final conclusion is, that $\mu_1 > \mu_2$, so the students' evaluation is better than teachers' evaluation.

H 5: Students were able to concentrate better during the online education than professors

Table 5: The results of the hypothesis testing procedure for question 5.

Hypothesis testing for Question 5. Have you/your students been able to concentrate the same way both during online and offline education?					
F -test		t -test		$Welch$ -test	
Test statistics	2.03	Does not work		Test statistics	2.30
Critical value	1.39			Critical value	1.98
Conclusion	$\sigma_1 \neq \sigma_2$			Conclusion	$\mu_1 \neq \mu_2$

Considering F -test, the null hypothesis must be rejected, the standard deviations are not equal, and since $s_1^2 = 1.58; s_2^2 = 0.77$, the ratio of variances is greater than 2, so the t -test can't be applied. $Welch$ -test is applicable, which says that expected values are not equal. As a result, we can conclude, that there is significant difference between the students' and the teachers' opinion, considering question 5. Taking into account, sample mean values, that are $m_1 = 3.11$ and $m_2 = 2.80$ respectively, the final conclusion is, that $\mu_1 > \mu_2$, so the students' evaluation is better than the teachers' evaluation.

Research Question 6: Students felt less technical distractions during online education than professors.

Table 6: The results of the hypothesis testing procedure for question 6.

Hypothesis testing for Question 6. Have you had disturbing factors during online education?					
<i>F</i> -test		<i>t</i> -test		<i>Welch</i> -test	
Test statistics	2.47	Does not work		Test statistics	5.89
Critical value	1.39			Critical value	1.98
Conclusion	$\sigma_1 \neq \sigma_2$			Conclusion	$\mu_1 \neq \mu_2$

Considering *F*-test, the null hypothesis must be rejected, the standard deviations are not equal, and since $s_1^2 = 1.32$; $s_2^2 = 0.53$, the ratio of variances is greater than 2, so the *t*-test can't be applied. *Welch*-test is applicable, which says that the expected values are not equal. The empirical mean values are $m_1 = 2.47$ and $m_2 = 1.79$ respectively. We can conclude, that there is a significant difference between the students' and the teachers' opinion, considering question 6. Taking into account the empirical means, the final conclusion is that $\mu_1 > \mu_2$, so the students' evaluation is better than the teachers' evaluation.

IV. Conclusions

There are several conclusions to be drawn that we have learnt from our research.²⁰ The students and the professors missed the offline education equally, because not only the transferring of the teaching material counts, but the presence of the social interactions as well, which cannot be substituted by any IT system. There was a tight time frame during the tests for students, and the deadlines were too short. Its effectiveness was not equal to the traditional education. During the online education, the same amount of material cannot be conveyed as in the offline one. It by no means substitutes the offline one, and the online education made the education process monotonous. The laptop was sometimes useless, the Teams system froze, and the laptop couldn't cope with it. To prevent future misunderstandings between students and professors, we recommend the introduction of a generally standardized set of rules, or a code of ethics to adapt the new online teaching method: the students must be present by their picture at least at the beginning of the seminar and at the end of it when saying goodbye, upon no request. A new minimal online educational standard should be elaborated. In case of offline education, professors could experience, that their enthusiasm concerning the topic attracted the students, because they could see the body-language, and the mimics as well, which cannot be seen from a „stamp”. Our hypotheses are partially justified: the online education as a whole, meant more negative aspects for both the teachers and the students as well, than positive ones. The online education can only be successful and accepted, if it is gradually initiated into the academic curriculum, which is in line with the international experience and HÖK recommendation as well. Our proposals are that the initiation of online education shall only be in case of lectures, correspondence education, and theoretical modules, whereas the practice sessions should remain in contact form.

V. References

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